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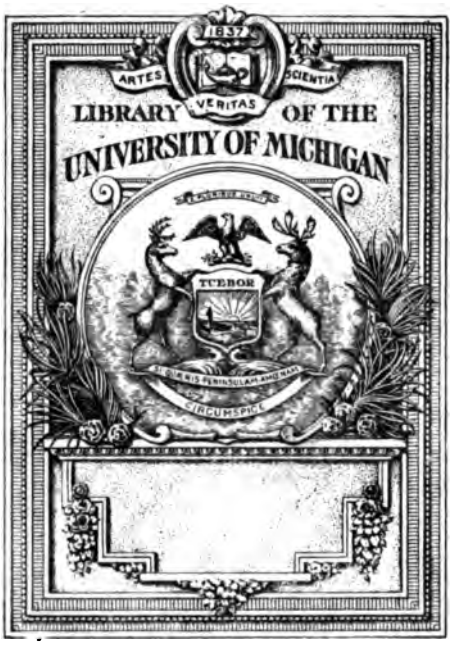

THE GIFT OF
Hon. O. H. Spaulding

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REPORT

OF THE

SECRETARY OF WAR;

BEING PART OF

THE MESSAGE AND DOCUMENTS

COMMUNICATED TO THE

TWO HOUSES OF CONGRESS

AT THE

BEGINNING OF THE SECOND SESSION OF THE FORTY-FIFTH CONGRESS.

VOLUME III.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1877.

REPORT

OF THE

CHIEF OF ORDNANCE.

118229

REPORT OF THE CHIEF OF ORDNANCE.

WAR DEPARTMENT, ORDNANCE OFFICE,
Washington, October 5, 1877.

The Hon. SECRETARY OF WAR:

SIR: I have the honor to submit the following report of the principal operations of the Ordnance Department during the fiscal year ended June 30, 1877, with such remarks and recommendations as the interests of this branch of the military service seem to require.

The fiscal resources and disbursements of the Department during the year were as follows, viz:

Amount of appropriations in Treasury June 30, 1876	$148,440 93
Amount in Government depositories to credit of disbursing-officers on same date	188,471 21
Amount arising from exchange of powder on same date	17,368 50
Amount of deposits in Treasury not reported to the credit of the appropriations on same date	3,482 98
Amount of appropriations from July 1, 1876, to June 30, 1877, including the fixed annual appropriation for arming and equipping the militia.	1,128,625 98
Amount from the appropriation for sales of ordnance material	75,000 00
Amount of appropriation for "allowance for reduction of wages under eight-hour law" on accounts audited and allowed during the year	310 73
Amount (net) received since June 30, 1876, on account of damages to arms in hands of troops, from sale of arms to officers, and of condemned stores, and from all other sources not before mentioned	173,917 59
Total	1,735,617 92

Amount of expenditures since June 30, 1876	1,369,958 50
Amount reported as in the Treasury June 30, 1876, not carried to the appropriations, now covered in as miscellaneous receipts on account of sales of ordnance stores	2 86
Amount deposited in the Treasury during the fiscal year ending June 30, 1877, as miscellaneous receipts	130,185 28
Amount of deposits not reported to the credit of the appropriation on June 30, 1877	3,919 99
Amount turned in to the "surplus fund" on June 30, 1877	12,071 55
Amount in Government depositories to the credit of disbursing-officers on June 30, 1877	194,122 95
Amount of appropriations in the Treasury June 30, 1877	25,356 79
Total	1,735,617 92

During the past fiscal year the manufacture of small-arms at the National Armory, and of metallic ammunition, infantry, cavalry, and

horse equipments, and all minor ordnance stores and supplies with their care and preservation, at our several arsenals; the distribution of supplies to the Army, Militia, and Marine Corps, and designated colleges; the inspection and testing of inventions; the conversion of smooth-bore cannon into rifles at the West Point and South Boston foundries, and the proof and trial of heavy cannon, field-guns, mitrailleuses, powder, projectiles, &c., at the proving-ground at Sandy Hook; and the care and preservation of the several arsenals with their many millions of dollars of public property, together with details at the headquarters of military divisions and departments, have given ample employment to the officers of the corps.

Their stations and duties on June 30, 1877, were as follows: 2 at the Ordnance Office, 35 officers and 9 ordnance storekeepers at the arsenals, 4 at the Military Academy, 6 on the ordnance board and foundry duty, 7 at the headquarters military divisions and departments, and 1 ordnance storekeeper on sick-leave.

Since the 1st of July all the principal operations at the armory and arsenals have been suspended for want of appropriations, and only such employés have been retained as are indispensable for the care and protection of machinery and stores, and to make the issues necessary to supply the Army. In some cases guards of citizens have had to be employed, because of the small number of enlisted men allowed to the Department. During the recent disturbances it was found essential to the protection of these national establishments to station troops of the line at the most exposed arsenals, and in two cases the want of soldiers had to be made up by companies of marines, which were cheerfully ordered by the honorable Secretary of the Navy to the Watervliet and Frankford arsenals. Col. P. V. Hagner, commanding the former, and Maj. J. M. Whittemore, commanding the latter, bear witness to the soldierly conduct, cheerful assistance, and satisfactory service rendered by them during their stay on duty as guards. The call for such assistance is proof positive that the strength of our ordnance detachments at the arsenals is not sufficient for their protection, in troublous times, from sudden and unexpected attacks, even from a mob. It shows that the vast accumulation of public property at these establishments, valued at over sixty millions of dollars, ought always to be kept under so strong a military guard as would insure its safety under all emergencies. It is needless to surmise what would be the result should a mob take possession of an arsenal with its large resources of arms, ammunition, &c., and yet at the very height and in the midst of the recent riotous disturbances one of our arsenals had only twenty soldiers to protect it. In my opinion, one thousand enlisted men will not be too many to perform these important and imperative duties to the satisfaction of the country, and it is earnestly recommended that the number of ordnance soldiers be so increased.

SMALL-ARMS.

The failure of the Army appropriation bill for the present fiscal year to become a law at the last session of the Forty-fourth Congress necessitated the closing of the National Armory on 1st July and the discharge of all the operatives there employed. Our records show that on the 1st instant there were in store as a reserve supply only 8,552 rifles and 5,983 carbines, or a total of 14,535 arms, of the latest model. I have submitted an estimate of $900,000 to enable the Department to manufacture during the next fiscal year at least 50,000 arms. Believing that such a country as this, with its great natural resources, abundant wealth, an exposed frontier of many thousands of miles, with a shore-line of as many thousand more, should, as a measure of ordinary safety, have always in store not less than half a million of the best and most efficient arms, the manufacture of one-tenth that number during the next year seems so necessary as to call for no argument. It may be true that our policy is peace. If so now, it has been so for a century, and yet during that short period in the existence of the nation we have had not only countless wars with the Indian tribes, but wars with the nations contiguous to our boundary north and south, and the great war of the rebellion. Is it to be expected that a continuance of such a peace policy will, in the present century of the country's life, be more successful in keeping us free from a fair proportion of conflicts in which peace can only be maintained at the sacrifice of men and means? The experience of the most enlightened nations in the past, the gigantic struggle now being waged on the continent, that may ere it closes involve other powers and subject all Europe to the horrors of war, prove how far we are yet from a realization of a peace that will last longer than time enough to prepare for a new conflict. If old-established communities, with the cumulative wisdom and experience of centuries to guide them, seem to exist only under the protection of armies, is it to be expected—with the record of our wars during the past century before us—that the United States, almost the youngest in the family of nations, can enjoy a future different from theirs? To be prepared for war is one of the most effective means of preserving peace. Such preparations, to be efficient and complete, must, however, be made at leisure, with all the skill, experience, and means of which we are capable. In making them, time is an element not to be ignored or despised. The progress in invention and of the mechanic arts must be consulted and kept in view in the work of preparation, because the approved article of the past may have become the mere stepping-stone to the perfected improvement of the present. What fifteen years ago was deemed a perfect musket is now classed as obsolete with hardly a marketable value, and that marvel of mechanism of to-day, the breech-loading rifle, must soon make room for a still greater marvel in simplicity and effectiveness. In our preparations, we must keep abreast of the progress of the age. Get the best of to-day, with

the certainty that it must yield to the best of to-morrow. And it is this unceasing, ever-changing, still improving march that enforces constant and unremitting study, and labor, and change, and improvement on the part of governments the world over, that they may be thoroughly prepared in the day of trial, not with the obsolete appliances of a past age, but with the perfected mechanism of the present. This constant change of model and pattern involves all countries in great expense in fact, in never-ending drafts on their exchequers. But unless a grand council of the nations should decide and fix on the kind, character, and quality of the weapons that are to be used in war, there is but one unerring, unfailing guide to the character of an armament, and that is that it shall be equal, and if possible superior, to that of all others. This entails the constant expenditure of large sums; but such expenditures are more than repaid by the first victory that prevents the capture of a capital or the desolation of a district. At any rate, there is no way known to the world to avoid such a course of procedure, and the necessities of modern warfare demand a thoroughness and completeness in the preparations that no country can neglect.

It is in this view that a large appropriation for the manufacture of arms at the National Armory is deemed imperative. The rifle issued to the Army and the militia compares favorably with the best breech-loader either here or abroad. This was conclusively shown recently in the "inter-state military" match at Creedmoor. In the hands of the California team, from General McComb's brigade, the score made is said never to have been equaled in a military team match. It is an arm that may not be superseded for many years to come, and if it be obliged to yield to one of superior merit, the effect will not be to render it obsolete, but to make it secondary to one using the same cartridge but having greater rapidity of fire, so that the present single breech-loader will always be a powerful weapon, even when compared with the possible magazine-gun of the future. We cannot be wrong in laying up a reasonable supply of these, therefore, especially as the magazine-gun that may some day be adopted for Army service may require years of invention and improvements to reach that degree of simplicity in its mechanical arrangements necessary to render it suitable for the soldier.

METALLIC AMMUNITION.

In no one particular are we so lamentably deficient as in the supply of metallic ammunition.

Until recently only 10 rounds per man per month for target practice has been allowed, making a total of three millions of cartridges required annually for this very important purpose. Experience has conclusively proved that this allowance is entirely inadequate to teach the soldier the proper use of his rifle and perfect him as a marksman. Constant applications from the troops and from commanding generals for a larger supply clearly indicate its absolute necessity, and upon my recommen-

dation the allowance has been doubled, making the annual expenditure six millions of cartridges. This recommendation has been made notwithstanding the knowledge that the appropriations for several years back have been too small to render this expenditure a judicious one. The hope is however entertained that Congress may realize the crying necessities of soldiers who are constantly placing their lives at the mercy of some of the finest marksmen in the world, and by liberal appropriations enable this Department to provide all that may be required.

Our reserve stock of cartridges, caliber .45, is only nine millions.

MILITIA.

Congress is empowered by the Constitution, Art. I, Sec. VIII, "to provide for organizing, arming, and disciplining the militia," &c.

Section 1661 Revised Statutes provides that—

> The annual sum of two hundred thousand dollars is appropriated, to be paid out of any money in the Treasury not otherwise appropriated, for the purpose of providing arms and equipments for the whole body of the militia, either by purchase or manufacture, by or on account of the United States.—(Act 23d April, 1808.)

As the acts of May 8, 1792, and March 2, 1803 ,(sections 1628 and 1632, Revised Statutes,) required that "every citizen shall, after notice of his enrollment, be constantly provided with a good musket," &c.; "each dragoon shall furnish himself with * * * a pair of pistols, a saber, &c.," it would seem that by the act of 1808, (section 1661 Revised Statutes,) quoted above, the United States intended to practically rescind these requirements by appropriating money for providing arms, &c., for "the *whole* body of the militia," and relieve the citizen from the expense of his arms and equipments. (See Appendixes C and D.)

An abstract of the militia force of the United States, according to the latest returns, is given in the official Army Register for January, 1877, as follows:

Organized	90,865
Unorganized	2,875,469

These returns are presumably made under the provisions of section 1636 Revised Statutes.

They show an organized militia force of over ninety thousand men, which I am satisfied would be largely increased could the States be provided with the arms and equipments necessary. The present annual appropriation of only $200,000 will not arm and equip more than 8,000 infantry. If it be the intention of Congress to so provide the organized militia, a much larger appropriation is indispensable, and said appropriation should be increased from year to year as the organized is being recruited from the great mass of the unorganized. No greater incentive could be given than the assurance that provision had been made by Congress for this purpose. Recent events have conclusively proved that an armed force, well organized and disciplined, is as powerful to

maintain law and order as it has been to gain our independence and preserve our Union. Until our militia is by statute organized, disciplined, and well armed and equipped, as was evidently intended by the Constitution, our dependence in times of disorder and disturbance must be in our small standing army. In the light of the recent past, I know of no subject so fraught with interest and so pregnant with vital issues to the country at large in its future far and near, nor one that should arrest the attention of Congress more strongly, or more earnestly invite its patient consideration.

Not only should the permanent annual appropriation for arming and equipping the militia be increased to *one million of dollars*, but there should be some positive legislation fixing the responsibility and prescribing the method of accountability for these arms and equipments. Under the laws as they now exist, issues are made to the States on their respective quotas upon requisition from the governors thereof, and the responsibility of this office ceases with the consummation of the transaction.

No regular property returns of these arms, &c., as property of the United States, have ever been made to this office, although section 1636 Revised Statutes (act 2d March, 1803) would seem to call for such reports.

Some time since the question arose: "Whether, under existing laws, the right of property in the arms issued for arming and equipping the militia of the United States is vested in the State authorities, with power to dispose of them by sale or otherwise, without accounting to the United States." The opinion of the Attorney-General of the United States seems to be conclusive on this point, to wit, that the States are, "strictly speaking, invested with nothing more than a qualified property in such arms," and that they cannot "make any disposition or use of such arms which defeats the purpose referred to; though, if this should be done, there could seem to be no remedy without further legislation of Congress." Again he says: "In my opinion the States do not, by the existing laws, have the right of property in the arms issued for arming the militia, if an absolute right of property is there meant, and that they derive no authority under those laws to sell or dispose of these at their pleasure. As I have already observed, the statutes make no provision for any accountability whatever to the General Government respecting the disposition of the arms when they have been delivered to the States," &c. And again he says that the statutes require the arms "not only to be annually distributed, but to be transmitted by the General Government. After this is accomplished, the officers of the latter have nothing further to do with the arms so transmitted." (See Appendix V, page 683.)

A reference to this opinion of the Attorney-General induces me to call for further legislation by Congress. If the arms, &c., are not the *property of the* several States, but the right of property remains in the

General Government, then some law should be enacted fixing the responsibility, and requiring the necessary property returns to be made at stated periods to this office; and when any of this property shall be rendered unserviceable or unsuitable, it should be returned to the War Department, and if sales are made the money should be covered into the Treasury or used in replacing those sold. There seems to be no reason why the arms, &c., in the hands of the militia and of the States should not be accounted for in the same manner as is done in the Regular Army. Losses of arms or injury done to them should be charged either to individuals or to the States. To carry out these views I submit the following draught of a bill that will probably cover the case, and respectfully recommend that the matter may be submitted to Congress for its action.

AN ACT for the proper accountability and care of the arms, and so forth, issued to the several States and Territories for the militia thereof.

Be it enacted by the Senate and House of Representatives of the United States in Congress assembled, That the ordnance and ordnance stores issued to the several States and Territories for arming and equipping the militia, under the provisions of section sixteen hundred and sixty-one of the Revised Statutes, shall remain the property of the United States, and be annually accounted for to the Chief of Ordnance, United States Army, by the governors of the States and Territories in the same manner as ordnance and ordnance stores issued to the Regular Army are accounted for.

All ordnance and ordnance stores which may become unserviceable or unsuitable shall be examined by a board of officers of the militia, and its report shall be forwarded by the governor direct to the Chief of Ordnance, United States Army, for the action of the Secretary of War, who shall direct what disposition, by sale or otherwise, shall be made of them.

Loss of, or damage to, arms, &c., except the ordinary wear and accidents of service, shall be made good to the United States by the person or persons chargeable therewith, as in like case in the Regular Army.

Money received from sales, or on account of losses or damages to arms, and so forth, shall be accounted for to the Chief of Ordnance, United States Army, and paid into the Treasury of the United States.

The Chief of Ordnance, United States Army, under the direction of the Secretary of War, shall prescribe and supply the necessary blanks, and make such regulations touching the accountability, care, and disposition of the arms, and so forth, as he may deem necessary in the interest of the United States.

Under the "Joint resolution authorizing the Secretary of War to issue arms," approved July 3, 1876, arms, &c., have been issued to the following named "Territories and the States bordering thereon," in the manner and upon the conditions prescribed; good and sufficient bonds for the return of said arms, or payment for the same, having been given in each case. The issues aggregate 3,908 breech-loading muskets and carbines, (see Appendix F,) as follows:

1876.

Aug. 7.	Kansas.	500 breech-loading muskets, cal. .50; 500 Sharp's carbines, cal. .50.
Aug. 12.	Nebraska.	1,000 breech-loading muskets, cal. .50.
Sept. 17.	Montana.	500 breech-loading muskets, cal. .50.
Oct. 2.	Texas.	500 breech-loading muskets, cal. .50; 500 Sharp's carbines, cal. .50.

1877.

Apr. 17.	Colorado.	300 breech-loading muskets, cal. .50.
May 23.	Arizona.	48 breech-loading muskets, cal. .50;
		60 Sharp's carbines, cal. .50.

Since the beginning of the present fiscal year, there have been issued to the State of Oregon—

100 breech-loading muskets, cal. .50;
220 Spencer carbines, cal. .50;

and instructions have been given for an issue to be made to the Territory of Idaho.

Including the necessary supply of accouterments and ammunition, the issues thus far made and reported are valued at $86,220.83.

The following is an extract from "An act making appropriations, &c., for the support of the Army for the fiscal year ending June 30, 1876, and for other purposes," approved March 3, 1875:

And provided further, That so much of the appropriations between the 1st January, 1861, and the 9th April, 1865, under the act of April 23d, 1808, herein referred to, as would have been used for the purchase of arms to be distributed to the several States that were in rebellion, shall be covered into the Treasury of the United States.

The effect of this proviso was to render null and void an act approved March 3, 1873, under which all the States that had been in rebellion were credited on the books of this office with their respective quotas during the period mentioned, and arms and equipments were issued to such as made application, and charged against them accordingly.

The annulling of its provisions by the above quoted *proviso* does injustice to some of the States interested, by an unequal distribution of its benefits, and it is recommended that further legislation thereon be asked of Congress.

States which drew all their credits before the passage of the repealing proviso of 1875.

Arkansas	$15,595 63
Georgia	31,252 67
Louisiana	22,299 38
Mississippi	31,116 58
Tennessee	11,094 89
Texas	24,408 82
Virginia	48,404 79

States which failed to draw the credits under the act of 1873, *and which credits were covered into the Treasury under the proviso of* 1875.

Alabama	$21,196 91
Florida	7,314 99.
North Carolina	23,622 25
South Carolina	18,049 53

Section 3 of "An act making appropriations, &c., for the support of *the Army for the* fiscal year ending June 30, 1876, and for other pur-

poses," approved March 3d, 1875, provides that, under certain conditions therein named, credits be given to the several States and Territories for the sums charged to them respectively for arms, &c., which were issued to them between January 1, 1861, and April 9, 1865, and charged against their quotas under the law for arming and equipping the militia. The following table shows the value of stores issued between the aforementioned dates, the credits given under the law, and the balances remaining still unadjusted and charged against the States and Territories.

Statement of the value of stores issued between January 1, 1861, and April 9, 1865, of the credits given under act of March 3, 1875, and of balances yet to be adjusted under that act.

States.	Value of stores issued between January 1, 1861, and April 9, 1865.	Credit given under act of March 3, 1875.	Balances September 1, 1877.
California	$221,041 10	$182,281 51	$38,759 59
Connecticut	3,438 00	3,438 00	.....
Delaware	20,431 00	17,000 00	3,431 00
Illinois	98,674 40	.....	98,674 40
Iowa	923 00	923 00	.....
Indiana	16,910 13	.....	16,910 13
Kansas	44,231 00	44,231 00	.....
Kentucky	1,139 00	.....	1,139 00
Maine	13,959 25	13,959 25	.....
Maryland	1,188 00	1,188 00	.....
Massachusetts	25,210 00	25,210 00	.....
Michigan	7,294 00	7,294 00	.....
Minnesota	7,595 74	4,286 88	3,308 86
Missouri	5,330 00	.....	5,330 00
New Hampshire	32,964 00	1,660 00	31,304 00
New York	107,246 00	106,292 00	954 00
North Carolina	5,896 00	.....	5,896 00
Ohio	281,870 70	149,800 05	132,070 65
Oregon	14,416 57	.....	14,416 57
Pennsylvania	1,327 00	1,327 00	.....
Rhode Island	25,638 76	.....	25,638 76
Tennessee	8,803 00	.....	8,803 00
Vermont	638,358 37	28,537 22	609,821 15
Wisconsin	8,486 73	1,942 01	6,544 72
Arizona Territory	1,982 50	.....	1,982 50
Dakota Territory	10,022 34	.....	10,022 34
Nebraska Territory	8,487 00	.....	8,487 00
New Mexico Territory	45,251 00	.....	45,251 00
District of Columbia	1,976 00	.....	1,976 00
Total	1,660,090 59	589,369 92	1,070,720 67

ARMAMENT OF FORTIFICATIONS.

An estimate of $950,000 for this purpose has been submitted for the next fiscal year. The conversion of our useless, because obsolete, 10-inch smooth-bore guns into efficient 8-inch rifles, by the insertion of wrought-iron tubes of American manufacture, has been very satisfactory, and has progressed as rapidly as the small appropriation made by Congress would admit of. The trial gun with American tube has already been fired five hundred and ninety rounds, and still remains in a good and serviceable condition. There are on hand at our forts over eleven hundred of these smooth-bore guns that can be conveniently made into rifles for our case-mate batteries, where there is not room enough to accommodate heavier

metal. They can also compose, in the main, the armament of smaller forts protecting shallow channels that will not admit the heaviest ships. At one thousand yards they will be very effective against the ordinary iron-clads that are protected with less than eight inches of iron plate. They constitute a very essential portion of our armament, and can be prepared in our own country with the ore from our mines and the skill and labor of our own mechanics. One thousand of these guns could be judiciously mounted on the forts along our extended coast-line, and it is recommended that a liberal appropriation be made to continue the conversion economically and expeditiously.

Carriages for these guns are absolutely necessary. Those now on hand, made some years ago for the smooth-bore guns, are not in any sense suitable for rifle guns that fire 35 lbs. of powder and 180-lb. shot. They require extensive alteration, and the many mechanical appliances for moving, traversing, absorbing the recoil when fired, &c., without which the gun could not be relied on for service. A carriage for a gun of large caliber is a complicated piece of mechanism, made of wrought iron and other metals, weighing at least one-half the weight of the gun, and costing in about the same proportion, demanding much careful study and calculation to adjust the relation of the parts to each other and to the work to be performed, and requiring much mechanical contrivance to accomplish the desired result. After long study and mature consideration of all the conditions to be fulfilled by a carriage for our largest guns, the one devised by Lieut. Col. S. Crispin, "Constructor of Ordnance," has been approved. It embodies some original ideas and all the best features used in such constructions, combined so skillfully—every part so well adapted to its special use—as to make it strong, economical, and as simple as the varied character of the work it is expected to perform will permit; and great credit is due to Lieutenant Colonel Crispin for the distinguished success that has crowned his labors in designing so perfect a piece of mechanism. A general description of it is submitted in Appendix T. In Appendix P will be found succinctly recorded the report of "The Ordnance Board" on the most economical methods of so altering our old carriages as to adapt them to the requirements of rifle guns. An appropriation is asked for to enable the Department to provide suitable carriages, either by alteration or original construction, for the guns as fast as they are ready to be mounted.

Besides the 8-inch rifles above referred to, our forts are now prepared to receive larger calibers, namely, twenty 12-inch and five hundred and seventy-five 10-inch rifles, and Congress ought to appropriate money sufficient for making a substantial beginning in this most important portion of our armament. There is at present only one establishment in this country capable of undertaking the construction of these large guns. The plant is very expensive, and without some encouragement on the part of the United States, and some degree of permanence in the orders that are to be given annually, these private parties cannot be expected to

risk the investment of money to keep the expensive plant in condition for immediate and efficient work, with no more in prospect than the disheartening uncertainties of the past decade. A consideration of the urgent wants of our sea-coast defenses, the length of time required to supply those wants, the absolute impossibility of providing for them in time of danger, when the events of years are crowded into days, the wisdom and policy of fostering our mechanical industries for the manufacture of warlike stores in the absence of a Government foundry, the economy of products which are the results of paying orders and steady labor, satisfies me that a permanent annual appropriation for the armament of fortifications would be most judicious and satisfactory in the interest of the public purse and the public service.

POWDER DEPOT AND MILLS.

An estimate of $100,000 has been submitted for the establishment of powder-mills for the manufacture of experimental powders and powders for our peace establishment, and a depot on the Atlantic coast for its storage and preservation. At present our supply has to be stored either in our forts, where it is subject to rapid deterioration, or in our arsenals and magazines, in the midst of closely-populated districts. The loss from the former, caused by the damp sea air, is estimated at twelve per cent. annually; and from the latter, should an explosion occur, the loss would be incalculable, so that provision for the storage depot is called for by reasons of interest and humanity; (see pages 599–607.) There can be no question that the Government should have a powder-mill of its own. The gunpowder now adopted for large ordnance has no ordinary marketable value, it being used exclusively for war purposes. It requires some special machinery and appliances, much experiment and trial, and should be under Government control. The determination of the many scientific and mechanical questions of detail that enter into its manufacture, the fixing of standards for the guidance of private mills in case of war, when all the resources at command must be called into requisition, the economy of their manufacture for the Army and militia in time of peace, would seem to make a powder-mill one of the necessities of the service.

MACHINE-GUNS.

During the past few years the invention of the mitrailleuse has introduced a new element in the character and power of our armament. The Gatling gun may be considered the pioneer among the successful few, and in its crude state dates back to its use in the early days of the rebellion. Since the war it has been perfected and introduced *first in this country* by the purchase of one hundred guns in 1866, and afterwards into many countries throughout the world, where it has made a record that challenges comparison with any other mitrailleuse of which we have any knowledge. Its power has thus far been limited practically

to a concentrated fire of wonderful rapidity and intensity, but not exceeding the capacity in accuracy and range of the ordinary small-arm, using the same cartridge. I say practically, for although guns of one-inch caliber have been made, some of which are now in our service, only solid shot and canister are provided, the former of course available at ranges beyond the attainment of the ordinary rifle. The Gatlings may then be considered as supplementary to the small-arm, with great efficiency and effectiveness, but not rising to the power and dignity of a field-gun.

The Hotchkiss revolving cannon does no violence to its name, because in great accuracy and long range, in rapidity of fire and deadly effect of its shells, it is a *cannon* in its uses and effects, a powerful auxiliary for field service and flank defence, that lifts it above the plane of an ordinary mitrailleuse. "The Ordnance Board," in its able and interesting report, very truly says that it "cannot be classed with mitrailleuses in the ordinary sense of the latter term, as explosive shells are fired with the former, and it has a range equal to that of field artillery. And, again, "The introduction of this gun has marked a new departure in that class of arms which next succeeds in power the personal weapons of the soldier; and it gives fair promise as a powerful auxiliary to our modern field system, and to our present contemplated armaments for the defence of the short flank-lines of our permanent works."

Its place is unquestionably side by side with our field batteries, its percussion shell capable of searching woods, underbrush, and inaccessible points, at distances up to three miles, and equally with the field shell signalling the result of its aim by its unfailing explosion. As an auxiliary in our field and permanent forts, its continuous fire of shell and canister at all ranges from the shortest flank to the extreme reach of its shell, would seem to fulfill all conditions and requirements.

The results of our trials at Sandy Hook (see Report of Ordnance Board, Appendix O) compare most favorably with those obtained in the extended and exhaustive trials made at Gavre, France, and in the more limited experiments in Brazil, and fully justify the board in its highly favorable estimate of its merits, and in its recommendation for further trials at the experimental ground, in actual field service and in our fortifications.

ARSENALS.

By the "Act making appropriations for sundry civil expenses of the Government for the fiscal year ending June 30, 1876, and for other purposes," approved March 3, 1875, the Secretary of War was "directed to cause an examination to be made into the condition of the United States arsenals east of the Mississippi River, and report to the next Congress how many of the same can be sold without interfering with the necessities of the military service, together with an estimate of the amount that can probably be realized from the sale of each of the same whenever such sale shall be directed by Congress."

Pursuant to the above provision, a board was convened in June, 1875, and, after a comprehensive and exhaustive study of our arsenal system, made its report in September, 1875. That report is again submitted, in the hope that some definite action may be taken by Congress to carry out its recommendations, which have received the strongest indorsements of this office and the approval of the War Department. Besides the National Armory we have seventeen arsenals and the proving-ground at Sandy Hook, or nineteen separate and distinct establishments, scattered from Maine to Oregon. Within the past few years eleven smaller arsenals have been disposed of, either by sale under congressional sanction or by transfers to the line of the Army. This reduction of one-third of the number would seem to be very material, were it not that they constituted the most unimportant in convenience of location and capacity for work. The number ought to be still further reduced to reach a purely working condition of the Department, in which the maximum results can be attained at a minimum cost.

The conclusions of the board are urgently recommended for favorable consideration. The country needs only a few manufacturing establishments and depots of supplies to fulfill all conditions and meet all demands. Our railroad system brings all portions of the country in such close proximity in point of time that but a few centers for manufacture and storage are essential for rapid and complete distribution of supplies. The simplest, most judicious, and most economical method to effect this object is, in my opinion, for Congress to authorize the Secretary of War to sell such arsenals as he may deem no longer needed for the public service, and to use the net proceeds in the erection of a large arsenal on the Atlantic coast, and in placing the arsenals retained in perfect repair.

Precedents for such congressional action are many, but reference is here made only to the "Act making appropriations for sundry civil expenses of the Government for the fiscal year ending June 30, 1876," approved March 3, 1875, which created a commission to make sale and conveyance of all lands, docks, &c., known as the navy-yard in Philadelphia, and provided that the net proceeds "shall be paid into the Treasury of the United States, and an amount equal to the sum so paid in is hereby appropriated to be expended by the Navy Department in removing the movable property of the Philadelphia navy-yard to League Island, and in building the necessary docks, wharves, shops, and buildings at League Island," &c., under certain restrictions therein provided.

Only $30,000 were appropriated for the "repairs of smaller arsenals," &c., during the current fiscal year, an amount entirely inadequate for the purpose. The amount so appropriated has been less every succeeding year, as if the decided policy of Congress was in harmony with my recommendation above, for surely if these arsenals are worth keeping they are worth preserving, and the sums allowed the past few years have not been sufficient to keep them in decent repair. The reduction of the number seems to be the only proper course in this regard, irrespective

of its necessity to enable the Department to concentrate its work and supplies.

Rock Island Arsenal.—An estimate of $599,100 has been submitted for continuing the erection of workshops and other buildings, and for other purposes, at the Rock Island arsenal. By the act of July 12, 1870, all money must be expended within the year for which it is appropriated, except in cases of contract. This iron rule, that forces the expenditure of an appropriation—if expended at all—between certain dates, ought to be relaxed in connection with the erection of arsenal-buildings, so that advantage might be taken of the best portion of the year for such work. Under it, the 30th of June of each year divides the working season into two parts, and makes an impassable gulf between the arrangements for material and labor of the two half years so divided. Such a policy can only result in necessary but useless expenditure of money.

Major Flagler, commanding the Rock Island arsenal, an officer of large experience in the economical and successful administration of affairs at that establishment, very properly says:

> It is apparent that such a system is inconsistent with the best economy. Accidents which no prudence or wisdom can foresee will occur to interfere with and upset plans—such as changes in prices of labor and material, strikes, failures of contractors to furnish materials at times and in quantities required, and difficulties in procuring foundations and other engineering work. A worse difficulty, inseparable from the system, grows out of its lack of adaptation to the legal fiscal year. Appropriations are available only from July 1st to June 30th, and in the middle of this occurs, in our climate, nearly six months of weather in which out-door building-work is impracticable. There is then, after some delay for making contracts, &c., only about three months of good weather in the fall, and from two to two and a half in the spring, for all work must be completed and gradually brought to a close before the end of June. Work must then cease, and workmen be discharged, in the best season, to wait until new appropriations are available.

This subject is deemed of sufficient importance to call for legislative action, and it is respectfully recommended that the attention of Congress may be called to the necessity for an amendment to existing laws. In this connection, and as a complement to such relaxation in the times for which appropriations are made available, the following views of the commanding officer of Rock Island arsenal are submitted. That an appropriation in bulk of the entire amount necessary to complete the arsenal, to be expended in a series of years under restrictions as to the amount for each year, would undoubtedly be advantageous and economical, there can be no question. He says:

> Further great additional economy and advantage could be effected in the work of construction, if the whole amount required to complete all the arsenal-buildings were appropriated at once and placed at the disposal of the Secretary of War, to be used in such quantities each year as will permit the work to be done cheapest and in the best manner.
>
> It is believed that the truth of this statement would be made clear by a fair consideration of the difficulties enumerated above, and in connection with the fact that

the estimates for each year are liable to be cut down and articles stricken out, so that plans for economical work are interfered with. Different parts of the work are not done in each year simultaneously, as they ought to be, and often a less amount is done than can be done with the highest economy. Under such circumstances large gangs of carefully selected, tried, and organized workmen and foremen have to be discharged and are dissipated. The United States loses the advantage which permanent employment gives, of getting the best workmen at low wages, and only a small amount of work is done in some years with the machinery and means provided for doing a larger amount, while the cost of maintaining these means is nearly permanent.

It is believed that the adoption of the course recommended, instead of the system now pursued, ought and would save to the United States *not less than ten per cent.* of the whole cost of the work, and probably more. It is generally admitted that the armory and arsenal are to be completed; if so, the sooner it is done the better, and probably no time will come when the low prices of labor and materials will permit its accomplishment so cheaply as now, or when the employment it would furnish to laboring classes would be so great a boon as now.

Exclusive of machinery and shop fixtures, a total amount of $2,830,000 is a free estimate of the cost of completing the construction of the arsenal.

Last year I had the honor of submitting a special report on the necessity for a special appropriation of $157,350 for completing the development of the water-power at this arsenal. This item was also included in the estimates then submitted, and the necessity for the appropriation was fully discussed in the papers accompanying my annual report. No appropriation was made by Congress, but a "joint resolution to appoint a commission to examine into the matter of contracts made by and between the United States and the Moline Water-Power Company as to the water-power at Moline, Illinois, and to report to Congress as to the same," was passed March 3, 1877. Should the conclusions reached by the commission be in harmony with those so often expressed and urged by this bureau, it is hoped that Congress will take prompt action in the matter.

Appended to this report will be found an interesting and valuable "History of the Rock Island Arsenal" from its establishment in 1863, and of the island itself since 1804, prepared by Major Flagler, under my instructions. It records, in a permanent and accessible form, the many Indian treaties, laws, reports, agreements, assignments, &c., upon which its foundation and stability rest, and details its steady growth under the fostering care of Congress through succeeding years, to its present grand proportions. And, what is so valuable to the engineer and constructor, it frankly speaks of failures as well as successes, of the obstacles and difficulties as well as of the crowning achievements. Throughout this interesting recital it is not difficult to appreciate how thoroughly the success of this national enterprise is due to the incessant study and indefatigable labors of its present able and energetic commander, and of his highly distinguished predecessor, the late General Rodman.

REPORTS OF COLONEL LAIDLEY AND LIEUTENANT-COLONEL BENTON, ON EUROPEAN ORDNANCE MANUFACTURES.

On the 22d of May, 1873, the Secretary of War directed that Lieutenant-Colonel Laidley, Major Benton and Major Crispin, of the Ordnance

Department, United States Army, "proceed to England, France, Germany, Austria, and Russia, for the purpose of collecting information in regard to the construction of heavy cannon and other ordnance manufactures." * * * "The information gathered will, on their return, be submitted to the Chief of Ordnance." As their reports had to be made in the intervals taken from other important duties, there has been some delay in submitting them, (see Appendixes K and L,) but much of the information gathered has been well digested and already utilized in departmental constructions. Although their absence abroad was limited to one hundred days, and their field of observation an extended one, these reports exhibit marks of hard labor, careful study, technical knowledge, close examination, accurate observation, and descriptive power, that render them, in a high degree, interesting and instructive both to the professional student and the general reader.

ARTESIAN WELL AT BENICIA ARSENAL.

Considerable progress has been made during the past year in sinking the artesian well. The total depth bored is 1,407 feet 10 inches, but of this only 1,373 feet has been piped. In its present state water is pumped by letting down a deep-well pump two hundred feet. The water obtained is accompanied by inflammable gas, which can be lighted at the receiving reservoir two hundred feet away, where the water is delivered. Lieutenant-Colonel McAllister's report is herewith submitted, and an appropriation to enable him to prosecute the work to a successful conclusion is recommended.

INFRINGEMENT OF PATENTS.

In previous reports I have had the honor to refer at length to the subject of claims set up against this Department for alleged infringement of patents. During the last Congress it received the careful attention and consideration of both Committees of Patents, resulting in a bill reported to the Senate, accompanied by a favorable report, recommending the passage of the bill at an early day. The papers in the case are herewith appended, and I invoke such notice of the matter on the part of the Secretary of War as may result in proper consideration on the part of Congress.

I am the more urgent at this time for prompt legislative action, because of the very recent opinion of the

Supreme Court of the United States, No. 114, October term, 1876.

WM. H. CAMMEYER & SAMUEL LEWIS, appellants,
vs.
JOHN NEWTON, WASHINGTON ISETTS, CHAS. Eccleston, & Wm. L. Quinn.

Appeal from the circuit court of the United States for the southern district of New York.

Mr. JUSTICE CLIFFORD delivered the opinion of the court:

Holders of valid letters-patent enjoy, by virtue of the same, the exclusive right and *liberty of making and* using the invention therein secured, and of vending the same to

others to be used, as provided by the act of Congress, and the rule of law is well settled that an invention so secured is property in the holder of the patent, and that, as such, the right of the holder is as much entitled to protection as any other property, during the term for which the franchise or the exclusive right or privilege is granted.—(*Seymour* v. *Osborne*, 11 Wall., 533; 16 Stat. at Large, 201.)

* * * * * * * * * *

Public employment is no defense to the employé for having converted the private property of another to the public use without his consent and without just compensation. Private property, the Constitution provides, shall not be taken for public use without just compensation, and it is clear that that provision is as applicable to the Government as to individuals, except in cases of extreme necessity in time of war, and of immediate and impending public danger.—(*Mitchel* v. *Harmony*, 13 How., 134; *U. S.* v. *Russel*, 13 Wall., 627.)

Section twenty-two of the patent act provides that every patent shall "contain a grant to the patentee, his heirs and assigns, for the term of seventeen years, of the exclusive right to make, use, and vend the said invention or discovery throughout the United States."—(16 Stat. at Large, 201.)

Agents of the public have no more right to take such private property than other individuals under that provision, as it contains no exception warranting any such invasion of the private rights of individuals. Conclusive support to that proposition is found in a recent decision of this court, in which it is held that the Government cannot, after the patent is issued, make use of the improvement any more than a private individual, without license of the inventor, or making him compensation.—(*U. S.* v. *Burns*, 12 Wall., 252.)

Suppose that is so, then it follows that the decision in the case before the court must depend upon the question of infringement.

Claimants before this bureau for past use of inventions have, practically, but one remedy, and that is to bring personal actions against officers of the Ordnance Department. Such suits are now pending, and, if successful, will, under the above opinion of the Supreme Court, render the officers liable in their private means. The laws should in justice guard the officer from the anxieties and embarrassments of such a contingency, however remote it may seem, when, in obedience to orders from higher authority, he has performed a simple act of duty—a neglect of which would have subjected him to trial by court-martial.

As the proposed bill gives jurisdiction to the Court of Claims in all such cases where the United States is defendant, it would, I am confident, relieve the Department and its officers, as well as inventors and claimants, from the difficulties and annoyances that environ these important cases.

CLERICAL FORCE.

Attention is respectfully invited to my estimate asking for six clerks in addition to the present clerical force of this bureau. This office is divided into three divisions, and the chiefs of these divisions have been, and should be, graded and paid as fourth-class clerks.

This estimate conforms to the number and grades for which appropriation was made for the fiscal year ending June 30, 1876, and which was found barely sufficient to transact the business of this office promptly and efficiently.

In the appropriation for the year ending June 30, 1877, a reduction of one fourth, one third, one second, and two first class clerks was made, and in the appropriation for the present fiscal year a further reduction of one fourth-class clerk.

The reduction in the fiscal year 1877 caused a falling off in the number of property returns examined of over one thousand, (1,000,) and since July 1, 1877, over eight hundred (800) returns have been received which have not yet been examined, owing to the inadequacy of the clerical force. This increasing delay in the examination and adjustment of property accountability is often the unintentional cause of injustice to the officers of the Army and of pecuniary loss to the United States.

I have the honor to submit the following papers, heretofore referred to:

Appendix A.—Statement of principal articles procured by purchase and fabrication at the arsenals during the year ended June 30, 1877.

Appendix B.—Statement of ordnance, ordnance stores, &c., issued to the Regular Army and to posts during the year ended June 30, 1877.

Appendix C.—Apportionment, for the fiscal year ended June 30, 1877, of the annual appropriation of $200,000 for arming and equipping the militia, under sections 1661 and 1667 Revised Statutes.

Appendix D.—Statement of ordnance, ordnance stores, &c., distributed to the militia from July 1, 1876, to June 30, 1877, under section 1667 Revised Statutes.

Appendix E.—Statement of ordnance, ordnance stores, &c., distributed to colleges from July 1, 1876, to June 30, 1877, under section 1225 Revised Statutes.

Appendix F.—Statement of ordnance stores, &c., distributed to the Territories, and States bordering thereon, from July 1, 1876, to June 30, 1877, under the joint resolutions of July 3, 1876, and March 3, 1877.

Appendix G.—Showing stations and duties of the officers of the Ordnance Department on the 30th of June, 1877.

Appendix H.—History of the Rock Island arsenal.

Appendix H a.—Operations at Rock Island arsenal for year ending June 30, 1877.

Appendix I.—Pressure-gauges, dynamometers, densimeters, and coiled wrought-iron tubes.

Appendix J.—Infringement on patents.

Appendix K.—Colonel Laidley's report on European explosives.

Appendix L.—Colonel Benton's report on European ordnance and ordnance stores.

Appendix M.—Report of Board on arsenals.

Appendix N.—Report on deterioration of powder.

Reports of The Ordnance Board, viz:

Appendix O.—Trial of Hotchkiss revolving cannon.

Appendix P.—Altered carriage for the 8-inch converted rifles.

Appendix Q.—Firing with experimental guns at Sandy Hook, &c.

Reports of Colonel Crispin, Constructor of Ordnance, viz:

Appendix R.—Construction of 6-inch Moffatt breech-loading rifled howitzer.

Appendix S.—Construction of Dean's 3.5-inch bronze muzzle-loading field-piece.

Appendix T.—Proposed carriage and chassis for 12-inch rifle.

Appendix U.—Construction of 12-inch rifle.

Appendix V.—Opinion of Attorney-General in regard to the appropriation for arming and equipping the militia.

Appendix W.—Progress of boring the artesian well at Benicia arsenal.

I have the honor to be, very respectfully, your obedient servant,

S. V. BENÉT,

Brigadier-General, Chief of Ord

APPENDIX A.

Statement of principal articles procured by fabrication at the arsenals and by purchase during the year ending June 30, 1877.

CLASS I.

19 Gatling guns, caliber .45.
1 Moffatt flank-defense howitzer, caliber 6 inches.
1 Hotchkiss revolving cannon, caliber 1.5 inches.
1 Hotchkiss mountain-gun, caliber 1.65 inches.
1 3.5-inch rifled bronze field-gun.
43 8-inch rifles, converted.
1 10-inch rifle, converted.

CLASS II.

2 carriages for Gatling guns, caliber .45.
1 carriage and limber for Hotchkiss gun.
390 parts of artillery-carriages.

CLASS III.

10 buckets, sponge, wood.
20 feed-cases for caliber .45 Gatling gun.
5 gun-covers, various.
55 paulins, various.
1 pointing-apparatus for mortars.
4 powder-funnels, copper.
40 drifts for Gatling guns.
5 locks for Gatling guns.
6 rammers and staves for 8-inch gun.
6 scrapers for guns.
24 sponge-covers, various.
57 sponges and rammers, various.
52 sponges and staves, various.
1 tompion for 4.5-inch siege-gun.
91 vent-covers.
70 vent-pieces.
3 water-tubs.
78 parts of artillery implements.

CLASSES IV AND V.

1,908 8-inch Butler shot.
5 10-inch Butler shot.
8 8-inch Butler shells.
10 4.5-inch Butler shot.
10 3.15-inch Sutcliffe shot.
5 10-inch Dana shot.
50 9-inch Eureka shot.
5 10-inch Eureka shot.
100 3-inch Hotchkiss shot.
1,168 1.5-inch Hotchkiss shells.

50 3-inch Hotchkiss shells.
25 3-inch Hotchkiss case.
38 1⅝-inch Hotchkiss case.
25 3-inch Hotchkiss canister.
50 12-pounder shells.
900 sabots, various.

CLASS VI.

2,497 Springfield carbines, caliber .45.
2,913 Springfield rifles, caliber .45.
1,500 Springfield "cadet" rifles, caliber .45.
140 Sringfield officers' rifles, caliber .45.
1 Peabody-Martini rifle.
1 Winchester rifle, caliber .44.
16 double-barreled shot-guns.
2,003 Colt's revolvers, caliber .45.
5,003 Schofield's Smith & Wesson revolvers, caliber .45.
44 fencing-muskets and bayonets.
30 fencing-swords.
131,930 spare parts for small-arms.

CLASS VII.

3 sets cavalry-accouterments.
4,247 sets infantry-equipments.
1,000 graduated felt saddle-cloths.
11,504 saddle-blankets.
10,923 curry-combs.
12,500 sets knives, forks, and spoons.
8,038 meat-ration cans.
88,911 parts of infantry-equipments.
59,664 parts of cavalry-accouterments.
44,798 parts of horse-equipments.
32,762 appendages for small-arms.

CLASS VIII.

31,464 cartridge-bags, filled, various.
43,111 cartridge-bags, empty, various.
5,487,456 metallic ball-cartridges, caliber .45.
615,313 metallic blank cartridges, caliber .45.
500 metallic ball-cartridges, caliber .44.
5,500 lead balls, caliber .45.
4,675 canister for 1-inch Gatling guns.
1,500 pounds powder.
1,000 electric cannon-primers.
223,000 cartridge-primers.
1,000 percussion-caps.
250 Hotchkiss percussion-fuses.
133 fuses, experimental, various.
1,000 specimens cartridge-cases and bullets, caliber .45.

CLASS IX.

53 blocks, various.
2 hand-carts.
10 chock-handles.

1 densimeter.
4 platforms for siege-carriages.
10 rollers, long.
4 screens for targets.
10 shifting-planks.
16 skids.
2 slings, rope.
2 target-frames.
14 trace-ropes.
2 trunnion-loops.
1 rheostat.
1 printing-press.

MISCELLANEOUS.

546 arm-chests.
14 aprons, smith's.
2 ambulance-wagons.
2 ambulance water-kegs.
7,241 boxes, packing, wood.
1,227 boxes, packing, tin.
120 bolts and nuts, various.
41,993 pounds barrel-molds.
637 cans, tin.
1 cartridge-gauging machine.
1 cartridge-weighing machine.
1 punch-straightening machine.
1 pressure-dynamometer.
1 dynamometer, Benton's.
1 eprouvette for cartridges.
228 pounds fulminate of mercury.
2 hoisting-machines.
4 sets harness for post.
105 boxes leather-blacking.
27 gallons lacker.
10 star-gauge rings and points.
175 cast-iron heating-stoves for quartermaster's department.
3 tripods for Boulengé chronograph.
225 pounds black wax.
20,183 pounds paint.
4,937 tools and utensils, various.

APPENDIX B.

Statement of ordnance and ordnance stores issued to the Regular Army and to posts during the year ending June 30, 1877.

CLASS I.

19 Gatling guns, caliber .45.
2 Gatling guns, caliber .50.
1 Gatling gun, caliber 1 inch.
11 3-inch rifled guns.
2 4½-inch rifled guns.
4 8-inch rifled guns.
1 8-inch siege-howitzer.
2 8-inch siege-mortars.
2 10-pounder Parrott guns.
10 12-pounder bronze guns.
7 12-pounder mountain-howitzers.
1 24-pounder Coehorn mortar.

CLASS II.

24 Gatling-gun carriages.
1 Gatling-gun caisson.
15 3-inch-gun carriages and limbers.
11 3-inch-gun caissons and limbers.
3 4½-inch-gun carriages and limbers.
2 8-inch siege-howitzer carriages and limbers.
2 8-inch-mortar beds.
2 10 pounder Parrott-gun carriages and limbers.
13 12-pounder-gun carriages and limbers.
3 12-pounder-gun carriages without limbers.
2 12-pounder mountain-howitzer carriages.
5 12-pounder prairie-howitzer carriages and limbers.
11 12-pounder-gun caissons and limbers.
1 24-pounder Coehorn-mortar bed.
1 battery-wagon and limber.
7 cavalry-forges.

CLASS III.

17 sets of harness for near horse.
17 sets of harness for off horse.
34 sets of harness for 2 lead-horses.
32 sets of harness for 2 wheel-horses.
8 sets of harness for draught-horse.

CLASS IV.

747 3-inch canister.
591 3-inch case-shot.
1,722 3-inch shell.
136 3-inch shot.
100 4½-inch shell.
50 4½-inch shot.

25 9-inch shot.
236 15-inch shot.
120 10-pounder case-shot.
180 10-pounder shell.
96 10-pounder shot.
96 12-pounder case-shot.
146 12-pounder shot.
100 30-pounder shell.
59 100-pounder shell.

CLASS V.

73 3-inch canister.
163 3-inch case-shot.
1,090 3-inch shell.
120 3-inch shot.
18 8-inch siege-howitzer canister.
55 6-pounder gun case-shot.
180 10-pounder-gun canister.
927 12-pounder-gun canister.
925 12-pounder-gun case-shot.
1,178 12-pounder-gun shell.
170 12-pounder-gun shot.
438 12-pounder-howitzer canister.
314 12-pounder-howitzer case-shot.
572 12-pounder-howitzer shell.

CLASS VI.

578 Sharps' carbines, caliber .50.
3,995 Springfield carbines, caliber .45.
583 Springfield rifles, caliber .50.
140 Springfield muskets, caliber .58.
3,575 Springfield rifles, caliber .45.
20 smooth-bore muskets, caliber .69.
3 double-barrel shot-guns.
2,777 Colt's revolvers, caliber .45.
2 Colt's revolvers, caliber .44.
110 Remington revolvers, caliber .44.
2,695 Schofield's Smith & Wesson revolvers, caliber .45.
5 artillery-sabers
2,579 cavalry-sabers.
109 musician's swords.
22 non-commissioned officer's swords.
1,377 trowel-bayonets.

CLASS VII.

25 artillery-saber belts and plates.
230 cavalry-saber attachments.
5,361 cavalry-saber belts.
5,392 cavalry-saber-belt plates.
3,555 cavalry-saber knots.
3,220 carbine-cartridge boxes.
3,737 carbine-cartridge pouches.
6,002 carbine-slings.
5,428 carbine-sling swivels.
4,490 pistol-cartridge pouches.
6,714 pistol-holsters.

1,519 sets of infantry-equipments, complete.
4,316 bayonet scabbards, steel.
1,242 bayonet scabbards, trowel.
1,155 brace-yokes.
15,926 canteens and straps.
5,613 cartridge-belts.
1,490 cartridge-blocks.
245 cartridge-block carriers.
720 cartridge-boxes, No. 1.
302 cartridge-boxes, No. 2.
4,247 cartridge-boxes, caliber .45.
498 cartridge-boxes, caliber .58.
34 cartridge-box belts.
34 cartridge-box-belt plates.
484 cartridge-box plates.
710 cartridge-loops.
197 carrying-braces.
4,181 clothing bags and straps.
2,144 coat-straps.
136 frogs, sliding.
4,253 gun-slings.
14,244 haversacks.
8,468 meat-ration cans.
5,135 sets knives, forks, and spoons.
63 sword-belts and plates, non-commissioned officer's and musician's.
1,388 scabbards for intrenching-tools.
1,391 steady-straps.
4,122 tin cups.
995 valises.
25 waist-belts and plates, non-commissioned officer's and musician's.
3,340 waist-belts, private's.
3,342 waist-belt plates, private's.
7,306 bridles, curb.
5,932 bridles, watering.
845 carbine-sockets.
10,889 curry-combs.
2,398 girths.
9,521 halters.
9,521 halter-straps.
13,652 horse-brushes.
330 horse-covers.
12,868 lariats.
5,195 links.
9,818 nose-bags.
8,836 picket-pins.
6,264 saddles.
6,244 saddle-bags.
5,978 saddle-blankets, blue.
5,903 saddle-blankets, gray.
230 saddle-blankets, red.
3,286 saddle-cloths, felt.
8,567 side lines.
14,693 spurs.
15,076 spur-straps.
7,537 surcingles.

CLASS VIII.

11,500 revolver ball-cartridges, caliber .44.
727,444 revolver ball-cartridges, caliber .45.
72,700 revolver blank cartridges, caliber .45
1,936,660 carbine ball-cartridges, caliber .45.
3,071,000 rifle ball-cartridges, caliber .45.
129,700 carbine and rifle blank cartridges, caliber .45.
136,000 carbine ball-cartridges, caliber .50.
9,100 carbine and rifle blank cartridges, caliber .50.
100,800 Spencer carbine ball-cartridges, caliber .50.
125,550 rifle-ball cartridges, caliber .50.
40,000 elongated-ball cartridges, caliber .58.
2,800 Gatling ball-cartridges, caliber 1 inch.
1,300 Gatling canister, caliber 1 inch.
1,000 percussion-caps, pistol.
25 pounds buck-shot.
250 felt wads for shot-gun.

Ammunition for field-guns.

2,414 blank cartridges, ½-pound charge.
780 blank cartridges, 1-pound charge.
11,665 blank cartridges, 3-inch gun.
5,705 blank cartridges, 6-pounder gun.
7,950 blank cartridges, 12-pounder gun.
11,950 blank cartridges, 12-pounder howitzer.
12 blue-lights.
83,224 friction-primers.
3,735 fuses, assorted.
22,800 pounds cannon-powder.
5,000 pounds mammoth powder.
200 pounds mealed powder.
25,342 pounds mortar-powder.
103 pounds musket and rifle powder.
57 signal-rockets.

APPENDIX C.

Apportionment of arms for the fiscal year ending June 30, 1877, under the law of 1808 for arming and equipping the militia, as amended by the seventh section of the act approved March 3, 1855, and regulations established in conformity therewith.

States and Territories.	No. of Senators and Representatives.	Money-value.
Alabama	10	$4,797 85
Arkansas	6	2,878 71
California	6	2,878 71
Colorado	3	1,439 36
Connecticut	6	2,878 71
Delaware	3	1,439 36
Florida	4	1,919 14
Georgia	11	5,277 64
Illinois	21	10,075 49
Indiana	15	7,196 78
Iowa	11	5,277 64
Kansas	5	2,398 93
Kentucky	12	5,757 42
Louisiana	8	3,838 28
Maine	7	3,358 50
Maryland	8	3,838 28
Massachusetts	13	6,237 21
Michigan	11	5,277 64
Minnesota	5	2,398 93
Mississippi	8	3,838 28
Missouri	15	7,196 78
Nebraska	3	1,439 36
Nevada	3	1,439 36
New Hampshire	5	2,398 93
New Jersey	9	4,318 06
New York	35	16,792 48
North Carolina	10	4,797 85
Ohio	22	10,555 27
Oregon	3	1,439 36
Pennsylvania	29	13,913 76
Rhode Island	4	1,919 14
South Carolina	7	3,358 50
Tennessee	12	5,757 42
Texas	8	3,838 28
Vermont	5	2,398 93
Virginia	11	5,277 64
West Virginia	5	2,398 93
Wisconsin	10	4,797 85
Arizona Territory*	3	1,439 36
Dakota Territory*	3	1,439 36
Idaho Territory*	3	1,439 36
Montana Territory*	3	1,439 36
New Mexico Territory*	3	1,439 36
Utah Territory*	3	1,439 36
Washington Territory*	3	1,439 36
Wyoming Territory*	3	1,439 36
District of Columbia	3	1,439 36
Total	396	189,995 00
Freight, &c	.....	11,005 00
		200,000 00

*Apportionment according to the first paragraph of the President's regulation of *April 30, 1855.*

APPENDIX D.

Statement of ordnance, ordnance-stores, &c., distributed to the militia from July 1, 1876, to June 30, 1877, under the law of 1808, as amended by the seventh section of the act approved March 3, 1855.

CLASS I.

2 Gatling guns, 10-barreled, caliber .45. long.
1 Gatling gun, 5-barreled, caliber .45, new model.
8 3-inch wrought-iron rifled guns.
1 10-pounder Parrott gun, 2.9-inch bore.
8 3.3-inch Parrott guns.
8 light 12-pounder bronze guns.

CLASS II.

2 carriages and limbers for Gatling guns.
8 carriages and limbers for 3-inch rifled guns.
1 carriage and limber for 10-pounder Parrott gun.
8 carriages and limbers for light 12-pounder guns.
4 caissons and limbers for 3-inch rifled guns.
2 caissons and limbers for 10-pounder Parrott guns.
4 caissons and limbers.

CLASS III.

36 sets artillery-harness, 2 horses, lead.
24 sets artillery-harness, 2 horses, wheel.
16 artillery-whips.
45 feed-cases for Gatling guns.
12 gunner's haversacks.
12 gunner's pouches.
2 gunner's gimlets.
10 handspikes, trail, for field-guns.
72 harness-sacks.
34 lanyards for friction-primers.
14 pole-pads.
14 pole-straps, pairs.
12 priming-wires, field.
6 pendulum-hausses for 12-pounder gun.
19 paulins, 12 by 15 feet.
2 prolonges.
12 sponges and rammers for 3-inch rifled gun.
20 sponges and rammers for light 12-pounder gun.
7 sponges and rammers for 10-pounder Parrott gun.
12 sponge-covers for 3-inch rifled gun.
20 sponge-covers for 12-pounder gun.
2 tompions for 12-pounder gun.
34 thumb-stalls.
12 tube-pouches.
10 vent-covers, field-guns, old pattern leather straps.
2 vent-punches.

CLASS V.

96 3-inch solid shot.
96 3-inch case-shot.
32 3-inch shell.
32 3-inch canister.
400 12-pounder solid shot, fixed.
320 12-pounder spherical shot, fixed.
80 12-pounder shell, fixed.

CLASS VI.

3,371 Springfield rifles, caliber .50, models 1866 and 1868.
4,788 Springfield rifles, caliber .45.
744 Springfield "cadet" rifles, caliber .45.
2 Springfield rifles, (officers' model,) caliber .45.
2,765 Spencer carbines, caliber .50.
190 Springfield carbines, caliber .45.
192 Colt's revolvers, caliber .45.
2,002 Schofield's Smith & Wesson revolvers, caliber .45.
14 officers' swords, with two scabbards.
287 non-commissioned-officers' swords.
150 light-cavalry sabers.
156 light-artillery sabers.

CLASS VII.

6,360 bayonet-scabbards, steel.
822 bayonet-scabbards, leather.
4,110 cartridge-boxes, caliber .45.
3,592 cartridge-boxes, caliber .58.
60 carbine-cartridge pouches.
60 carbine slings and swivels.
5,543 gun-slings.
550 non-commissioned officers' waist-belts and plates.
250 non commissioned officers' shoulder-belts and plates.
334 saber-belts and plates.
197 saber knots.
1 set infantry-equipments, pattern 1872.
1 set infantry-equipments, pattern 1874.
6,002 waist-belts and plates, privates.
27 artillery-halters.
9 artillery-halter straps.
52 curb-bridles.
2,532 cavalry-saddles.
20 saddle-flaps.
20 sweat-leathers.
25 saddle-blankets.
66 spurs and straps.
4 surcingles.

CLASS VIII.

33,000 rifle ball-cartridges, caliber .45.
9,000 rifle blank-cartridges, caliber .45.
119,350 rifle ball.cartridges, caliber .50.
17,500 carbine ball-cartridges, caliber .50.
12,500 carbine ball-cartridges, caliber .45.

13,400 revolver ball-cartridges, caliber .45.
1,250,000 Henry carbine ball-cartridges, caliber .44.
32 12-pounder-gun cartridges, blank.
300 10-pounder-gun cartridges, blank.
7,400 friction-primers.
300 pounds cannon-powder.
2,000 pounds mortar-powder.
25 pounds musket and rifle powder.
2 pounds quick-match.
36 yards slow-match.
72 port-fires.

Parts for Springfield breech-loading rifle and carbine.

39 tumblers.
15 ramrods.
15 upper bands.
15 lower bands.
15 sears.
15 bridles.
15 upper-band springs.
15 lower-band springs.
15 stocks, walnut.
15 swivels, mainspring.
15 ejector-spring spindles.
4 side screws.
2 breech-screws.
30 rear sights, complete.
10 locks.
10 hinge-pins.
2 pounds wheel-grease.
12 pounds paint, lead-color.
3 pounds paint, black.
20 pounds paint, olive.
4 paint-brushes.

APPENDIX E.

Statement of ordnance, ordnance-stores, &c., distributed to the colleges from July 1, 1876, to June 30, 1877, under the joint resolution of May 4, 1870.

CLASS I.

8 6-pounder bronze guns.

CLASS II.

8 6-pounder-gun carriages and limbers.
2 6-pounder caissons and limbers.

CLASS III.

8 gunners' haversacks.
8 handspikes, trail.
16 lanyards.
8 priming-wires.
6 paulins, 12 by 15 feet.
16 sponges and rammers.
16 sponge-covers.
16 thumb-stalls.
8 tube-pouches.
8 vent-covers.

CLASS VI.

925 Springfield "cadet" rifles, caliber .45.
58 non-commissioned officers' swords.
8 musicians' swords.

CLASS VII.

625 bayonet-scabbards, steel.
350 bayonet-scabbards, leather.
1,125 cartridge-boxes, caliber .45, pattern 1874.
58 non-commissioned-officers' shoulder-belts and plates.
8 musicians' shoulder-belts and plates.
1,225 waist-belts and plates.

CLASS VIII.

100 blank cartridges for 12-pounder gun.
700 blank cartridges for 6-pounder gun.
1,400 friction-primers.
6,000 ball-cartridges, caliber .45.
6,000 blank cartridges, caliber 45.
5,700 ball-cartridges, caliber .50.
4,000 blank cartridges, caliber .50.

APPENDIX F.

Statement of ordnance stores, &c., distributed to the Territories and States bordering thereon from July 1, 1876, *to June* 30, 1877, *under the joint resolutions of July* 3, 1876, *and March* 3, 1877.

2,832 Springfield muskets, caliber .50.
15 Remington muskets, caliber .50.
1 Ward-Burton musket, caliber .50.
1,060 Sharps carbines, caliber .50.
1,005 carbine-slings and swivels.
2,353 cartridge-boxes.
16 cartridge-box belts.
1,332 bayonet-scabbards.
1,832 gun-slings.
2,848 waist-belts and plates.
102,500 metallic ball-cartridges, caliber .50.

APPENDIX. G,

Showing stations and duties of the officers of the Ordnance Department on the 30th day of June, 1877.

	Rank and name.	Duty.
	BRIGADIER-GENERAL.	
	Stephen V. Benét	Chief of Ordnance.
	COLONELS.	
1	P. V. Hagner, bvt. brig. gen	Commanding the Watervliet Arsenal.
2	F. D. Callender, bvt. brig. gen	Commanding the Augusta Arsenal.
3	T. T. S. Laidley, brevet	Commanding the Watertown Arsenal, and President of the United States Board to test Iron, Steel, &c.
	LIEUTENANT-COLONELS.	
1	J. G. Benton, brevet colonel	Commanding the National Armory.
2	J. McNutt, brevet colonel	Commanding the Washington Arsenal.
3	J. McAllister, brevet colonel	Commanding the Benicia Arsenal.
4	S. Crispin, brevet colonel	Commanding the New York Agency, Chief Ordnance Officer, Division of the Atlantic, President of the Ordnance Board and Constructor of Ordnance.
	MAJORS.	
1	J. W. Todd	Commanding the Saint Louis Arsenal.
2	T. J. Treadwell, bvt. lieut. col	Member of the Ordnance Board.
3	T. G. Baylor, brevet colonel	Commanding the New York Arsenal, and member of the Ordnance Board.
4	J. M. Whittemore, brevet	Commanding the Frankford Arsenal.
5	A. R. Buffington, brevet	Commanding the Allegheny Arsenal.
6	D. W. Flagler, bvt. lieut. col	Commanding the Rock Island Arsenal.
7	A. Mordecai, bvt. lieut. col	Instructor of Ordnance and Gunnery, Military Academy.
8	S. C. Lyford, bvt. lieut. col	On duty in the office of the Chief of Ordnance, and Chairman of Executive Departments Board, International Exhibition 1876.
9	F. H. Parker, brevet	Commanding the Fort Monroe Arsenal.
10	J. P. Farley	Commanding the Kennebec Arsenal.
	CAPTAINS.	
1	L. S. Babbitt, brevet	Chief Ordnance Officer, Department of the Columbia.
2	W. A. Marye, brevet	Assistant, Benicia Arsenal.
3	I. Arnold, jr., brevet	Commanding the Indianapolis Arsenal.
4	J. H. Rollins, brevet	Assistant, Watervliet Arsenal.
5	C. Comly, brevet	Commanding the San Antonio Arsenal, and Chief Ordnance Officer Department of Texas.
6	J. R. McGinness, brevet major	Chief Ordnance Officer Department of the South.
7	G. W. McKee, brevet major	Assistant, National Armory.
8	F. H. Phipps, brevet	Recorder of the Ordnance Board.
9	J. W. Reilly, brevet	Chief Ordnance Officer Division of the Missouri.
10	G. D. Ramsay, jr., brevet	Assistant, Indianapolis Arsenal.
11	J. A. Kress, brevet major	Commanding the Vancouver Arsenal.
12	O. E. Michaelis, brevet	Chief Ordnance Officer Department of Dakota.
13	W. Prince, brevet	Chief Ordnance Officer Department of the Gulf.
14	C. E. Dutton	Chief Ordnance Officer Department of the Platte, on temporary duty with Powell's geological survey of the Rocky Mountain region.

APPENDIX G, *showing stations and duties of officers, &c.*—Continued.

	Rank and name.	Duty.
15	J. G. Butler	Assistant, Watervliet Arsenal.
16	C. Bryant	Assistant to the Constructor of Ordnance.
17	M. L. Poland, brevet	Assistant, Benicia Arsenal.
18	A. L. Varney	Chief Ordnance Officer Department of the Missouri.
19	J. C. Clifford	Assistant, Rock Island Arsenal.
20	E. M. Wright	Assistant, Frankford Arsenal.
	FIRST LIEUTENANTS.	
1	J. E. Greer	Assistant, National Armory.
2	J. Pitman	Assistant, Watertown Arsenal.
3	C. Shaler, jr	Assistant Instructor of Ordnance and Gunnery, Military Academy.
4	H. Metcalfe	Assistant, Frankford Arsenal.
5	W. S. Starring	Assistant to the Constructor of Ordnance.
6	C. S. Smith	Assistant, New York Agency.
7	S. E. Blunt	Acting Assistant Professor of Mathematics, Military Academy.
8	F. Heath	Assistant, Frankford Arsenal.
9	D. M. Taylor	Assistant, Rock Island Arsenal.
10	D. A. Lyle	Assistant, National Armory, and on special duty experimenting with Life-Saving Apparatus, &c.
11	J. Rockwell, jr	Assistant, Rock Island Arsenal.
12	W. B. Weir	Assistant, Watervliet Arsenal.
13	J. C. Ayres	On temporary duty as Chief Ordnance Officer, Department of the Platte.
14	M. W. Lyon	Assistant, Allegheny Arsenal.
15	C. W. Whipple	Assistant to the Constructor of Ordnance.
16	A. H. Russell	Acting Assistant Professor of Philosophy, Military Academy.
	ORDNANCE-STOREKEEPERS. (*Not in the line of promotion.*)	
	E. Ingersoll, major	On duty, National Armory.
	W. R. Shoemaker, captain	In charge, Fort Union Arsenal.
	B. H. Gilbreth, captain	On duty, Watertown Arsenal.
	E. D. Ellsworth, captain	On sick leave.
	W. Adams, captain	On duty, Fort Monroe Arsenal.
	A. S. M. Morgan, captain	On duty, Rock Island Arsenal.
	W. H. Rexford, captain	On duty, Benicia Arsenal.
	F. Whyte, captain	On duty, Washington Arsenal.
	D. J. Young, captain	On duty, Watervliet Arsenal.
	M. J. Grealish, captain	On duty, Augusta Arsenal.

List of ordnance stations and officers on duty thereat.

	Ordnance stations.	State.	Officers on duty.
	Ordnance Office	D. C.	Brig. Gen. S. V. Benét, Maj. S. C. Lyford.
1	Allegheny Arsenal	Pa	Maj. A. R. Buffington, First Lieut. M. W. Lyon.
2	Augusta Arsenal	Ga	Col. F. D. Callender, Capt. M. J. Grealish, O. S. K.
3	Benicia Arsenal	Cal	Lieut. Col. J. McAllister, Capt. W. A. Marye, Capt. M. L. Poland, Capt. W. H. Rexford, O. S. K.
4	Fort Monroe Arsenal	Va	Maj. F. H. Parker, Capt. W. Adams, O. S. K.
5	Fort Union Arsenal	N. Mex.	Capt. W. R. Shoemaker, O. S. K.
6	Frankford Arsenal	Pa	Maj. J. M. Whittemore, Capt. E. M. Wright, First Lieut. H. Metcalfe, First Lieut. F. Heath.
7	Indianapolis Arsenal	Ind	Capt. I. Arnold, jr., Capt. G. D. Ramsay, jr.
8	Kennebec Arsenal	Me	Maj. J. P. Farley.
9	National Armory	Mass	Lieut. Col. J. G. Benton, Capt. George W. McKee, First Lieut. J. E. Greer, First Lieut. D. A. Lyle, Maj. E. Ingersoll, O. S. K.
10	Pikesville Arsenal	Md	In charge of a Sergeant of Ordnance.
11	Rock Island Arsenal	Ill	Maj. D. W. Flagler, Capt. J. C. Clifford, First Lieut. D. M. Taylor, First Lieut. J. Rockwell, jr., Capt. A. S. M. Morgan, O. S. K.
12	Saint Louis Arsenal	Mo	Maj. J. W. Todd.
13	San Antonio Arsenal	Texas	Capt. C. Comly.
14	Vancouver Arsenal	W. T.	Capt. J. A. Kress.
15	Washington Arsenal	D. C.	Lieut. Col. J. McNutt, Capt. F. Whyte, O. S. K.
16	Watertown Arsenal	Mass	Col. T. T. S. Laidley, First Lieut. J. Pitman, Capt. B. H. Gilbreth, O. S. K.
17	Watervliet Arsenal	N. Y	Col. P. V. Hagner, Capt J. H. Rollins, Capt. J. G. Butler, First Lieut. W. B. Weir, Capt. D. J. Young, O. S. K.
18	New York Agency	N. Y	Lieut. Col. S. Crispin, First Lieut. C. S. Smith.
19	New York Arsenal	N. Y	Maj. T. G. Baylor.
20	United States Military Academy.	N. Y	Maj. A. Mordecai, First Lieut. C. Shaler, jr., First Lieut. S. E. Blunt, First Lieut. A. H. Russell.
21	The Ordnance Board	.....	Lieut. Col. S. Crispin, Maj. T. J. Treadwell, Maj. T. G. Baylor, Capt. F. H. Phipps.
22	Military Department and Division Headquarters.	.....	Lieut. Col. S. Crispin, Capt. L. S. Babbitt, Capt. C. Comly, Capt. J. R. McGinness, Capt. J. W. Reilly, Capt. O. E. Michaelis, Capt. William Prince, Capt. C. E. Dutton, Capt. A. L. Varney, First Lieut. J. C. Ayres.
23	Special Ordnance Service	.....	Capt. C. Bryant, First Lieut. W. S. Starring, First Lieut. D. A. Lyle, First Lieut. C. W. Whipple.

APPENDIX H.

A HISTORY OF THE ROCK ISLAND ARSENAL FROM ITS ESTABLISHMENT IN 1863 TO DECEMBER, 1876, AND OF THE ISLAND OF ROCK ISLAND, THE SITE OF THE ARSENAL, FROM 1804 TO 1863; PREPARED, UNDER THE INSTRUCTIONS OF BRIG. GEN. STEPHEN V. BENÉT, CHIEF OF ORDNANCE, U. S. ARMY, BY MAJOR D. W. FLAGLER, ORDNANCE DEPARTMENT, BREVET LIEUTENANT-COLONEL, U. S. ARMY.

ROCK ISLAND ARSENAL, ILL., *March* 13, 1877.

Brigadier-General S. V. BENÉT,
Chief of Ordnance, U. S. Army, Washington, D. C.:

SIR: In obedience to your instructions I have prepared, and have the honor to transmit herewith, a history of the Rock Island arsenal from its commencement till December, 1876, including also a history of the island of Rock Island from the time it was acquired by treaty with the Indians in 1804.

In preparing this history I have endeavored to record all that is now or may hereafter become interesting as matter of history; to record and place in convenient form for reference all information in regard to the arsenal that the Department or officers stationed at the arsenal can ever require; to exhibit the present status of the work and show some of the laws and influences that are favorable or deleterious to its prosperity; and particularly to record and explain all successes and failures encountered, in order to make the book as valuable as may be for reference and guidance in the prosecution of similar work hereafter.

Very respectfully, your obedient servant,

D. W. FLAGLER,
Major of Ordnance, Commanding.

CHAPTER I.

HISTORY OF THE ISLAND OF ROCK ISLAND FROM 1804 TO ITS OCCUPATION BY THE ORDNANCE DEPARTMENT, UNITED STATES ARMY, FOR AN ARMORY AND ARSENAL, IN 1863.

General Harrison's treaty with the Sac and Fox tribes of Indians in 1804—Treaty not signed by Black Hawk—He refused to keep it—Various opinions—Condition of the country in 1812—Hostile Indians—General Clark's expedition, war of 1812—Fight of Americans under Captain Yeizer with the British and Indians under Colonel McCay—General Benjamin Howard's command—Capt. John Campbell's expedition—Maj. Zachary Taylor's engagement with the British and Indians at Rock River—Fort at Prairie du Chien captured by the British—Close of the war of 1812—Col. Thomas A. Smith and troops landed on Rock Island in 1816—Construction of fort commenced by Colonel Lawrence, Eighth Infantry—Description of Fort Armstrong—Extract from speech by Black Hawk—Cause of hostility on the part of the Indians—Black Hawk war—Keokuk and tribe move to the Iowa River, 1828—Lands at Rock Island surveyed and sold by United States, 1828—Black Hawk and bands refuse to leave—Black Hawk wants settlers to leave, 1831—Governor Reynolds marches with 1,600 volunteers to Rock Island—General Gaines goes from Saint Louis to Rock Island with the Sixth United States Infantry—Talk between Gaines and Black Hawk—Gaines and Reynolds join forces near mouth of Rock River, 1831—Black Hawk leaves village—Treaty of peace signed by Black Hawk June, 1831—Black Hawk breaks treaty—Recrosses river April, 1832—General Atkinson goes to Rock Island with First United States Infantry—Governor Reynolds, with 2,000 volunteers, marches to Rock Island—Eminent men in this expedition—Attempt to capture Fort Armstrong by Indians—

Reasons for failure—Principal actions during the war—Black Hawk made prisoner—General Scott arrives at Rock Island—Cholera among troops—Black Hawk's subsequent history—No Indian hostilities after Black Hawk war—Fort Armstrong evacuated—Indian agents in charge till 1840—Ordnance depot at Rock Island 1840 to 1845—Island in charge of War Department agents 1845 to 1862—Names of agents—Efforts of squatters, railroad, and water power companies, manufacturers, and others to obtain title to lands on island—High estimates of the island's value—Opinions of eminent men of its value as site for armory and arsenal—Abstract from books of General Land-Office of action taken by Government respecting the island—Letters and reports indicating intention of Government to locate an armory and arsenal on Rock Island—Captain Bell's report—Act of 1841 for selecting a site for a Western armory—Appointment of board to select site—Report on Rock Island—Extracts from letters of eminent men, showing the value of the island for military purposes—The island supposed to be transferred to the Interior Department and open for pre-emption in 1848—Report of General Buckingham—Letter of General Ramsay, Chief of Ordnance—Attempts of various parties to get possession of the island—Claim of George Davenport established by act of Congress—Statement of depredations committed on island by squatters—President Martin Van Buren orders the removal of intruders from the island—Attempts to carry out this orderin effectual—The Moline Water-Power Company's claim—D. B. Sears's claim—Proposed sale of island in 1850—Orders issued for its sale—Excitement at Rock Island—Revocation of the order—List of trespassers on the island in 1854—Spencer H. White applies for permission to lease lands—Bill introduced in United States Senate for sale of the island in 1854—Secretary of War Davis prevents passage of bill—Notice to leave the island served on all trespassers by United States marshal in 1852—Protests from Moline Water-Power Company and others—Permission from Secretary of War for parties to remain temporarily—Indenture—Act of Congress of 1855 gives D. B. Sears permission to purchase land—Passage of act would have been prevented by Secretary of War had he known it—Case of Rock Island Bridge Company—Charter from State of Illinois—Right of way across island claimed under act of 1852—Tenure not satisfactory to officers of the company—Letter from John A. Dix—Complaints against the company—Motion for injunction overruled by Judge McLean—Pre-emptors—Attempts to prove that the island belonged to mass of public lands—Thales Lindsley—List of preemptors—They occupy the island—Attempt to procure title to land defeated—Thales Lindsley's scheme to obtain grant of land for a national university—Character of the university, objects proposed, &c.—Application to Congress—Failure of the scheme—Application of Pitts, Gilbert and Pitts, for long lease of lands—Proposed sale of the island by the War Department in 1858—Letters and reports from various parties exhibiting condition of island at this time—Extensive depredations, destruction of timber, &c.—General statement of conflicting interests affected by the proposed sale—Letters setting forth these interests—Sale advertised, but not completed—Senate bill No. 487, to sell the island in 1859, not passed—Thales Lindsley's scheme for great water-power and ship-canal—Lands on the island to be obtained thereby—Bill providing for same in Illinois legislature opposed by Moline Water-Power Company and not passed—Continued efforts of pre-emptors to obtain title to lands—Attempts given up in 1862—Other parties take the matter up—General statement of manner in which all claims against the United States were settled—Cost of the same—Opinion of United States Attorney-General Bates—Prison-barracks.

The United States acquired its title to the island of Rock Island through a treaty which was made by William Henry Harrison,* governor and superintendent of Indian affairs for the Indiana Territory and district of Louisiana, with certain chiefs of the Sac† and Fox‡ tribes of Indians, at Saint Louis, Mo., in November, 1804.

The principal articles of this treaty, which may be useful for reference, are as follows:

ARTICLE 1. The United States receive the united Sac and Fox tribes into their friendship and protection, and the said tribes agree to consider themselves under the protection of the United States, and of no other power whatsoever.

ART. 2. The general boundary-line between the lands of the United States and of the said Indian tribes shall be as follows, to wit: Beginning at a point on the Missouri River, opposite to the mouth of the Gasconade River; thence in a direct course so as to strike the river Jeffreon at the distance of thirty miles from its mouth, and down the said Jeffreon to the Mississippi; thence up the Mississippi to the mouth

* Afterward President of the United States.

† Also spelled Sauk, Sauke, and Saukee in Indian treaties and papers.

‡ Musquakee.

of the Ouisconsing River, and up the same to a point which shall be thirty-six miles in a direct line from the mouth of the said river; thence by a direct line to the point where the Fox River (a branch of the Illinois) leaves the small lake called Saknegan; thence down the Fox River to the Illinois River, and down the same to the Mississippi. And the said tribes, for and in consideration of the friendship and protection of the United States, which is now extended to them, of the goods (to the value of two thousand two hundred and thirty-four dollars and fifty cents) which are now delivered, and of the annuity hereinafter stipulated to be paid, do hereby cede and relinquish forever to the United States all the lands included within the above-described boundary.

ART. 3. In consideration of the cession and relinquishment of land made in the preceding article, the United States will deliver to the said tribes at the town of Saint Louis, or some other convenient place on the Mississippi, yearly, and every year, goods suited to the circumstances of the Indians, of the value of one thousand dollars, (six hundred of which are intended for the Sacs, and four hundred for the Foxes,) reckoning that value at the first cost of the goods in the city or place in the United States where they shall be procured. And if the said tribes shall hereafter, at an annual delivery of the goods aforesaid, desire that a part of their annuity should be furnished in domestic animals, implements of husbandry, and other utensils convenient for them, or in compensation to useful artificers who may reside with or near them, and be employed for their benefit, the same shall at the subsequent annual delivery be furnished accordingly.

ART. 4. The United States will never interrupt the said tribes in the possession of the lands which they rightfully claim, but will, on the contrary, protect them in the quiet enjoyment of the same against their own citizens and against all other white persons who may intrude upon them. And the said tribes do hereby engage that they will never sell their lands, or any part thereof, to any sovereign power but the United States, nor to the citizens or subjects of any other sovereign power, nor to the citizens of the United States.

ART. 7. As long as the lands which are now ceded to the United States remain their property, the Indians belonging to the said tribes shall enjoy the privilege of living and hunting upon them.

The other articles provided for the protection of the Indians on their own lands west of the Mississippi, (which were not ceded;) for the settlement of difficulties which might arise between the Indians and the whites; for the establishment of a military post on the west bank of the Mississippi, near the mouth of the Ouisconsing (Wisconsin) River, and for the establishment of Indian traders. This treaty was signed on behalf of the Indians by five chiefs of the two tribes. The Foxes and part of the Sacs always held that the sale of the lands was a just transaction, and that the treaty was good and binding. Black Hawk, the famous Indian hero of the Black Hawk war, was the principal chief of the Sacs, and did not sign the treaty, but held, during the wars of 1812 and the Black Hawk war, that the treaty was not binding. He had an important village, the great town of the nation, beautifully situated on Rock River, near where it empties into the Mississippi, and about four miles from Rock Island, and when under the treaty his village-site and surrounding rich lands were afterward sold to settlers, he resisted and fought to save his lands. His account of the signing of the treaty was that a white man had been killed by one of Black Hawk's men, and that when the murderer was put in prison in Saint Louis, four Indians of his tribe were sent thither to procure his release by paying a sum of money, and that these Indians were made drunk, and induced to sign the treaty. Other facts of history, and the treaty itself, seem to prove that this story, or at least its application, was without good foundation.

After the war of 1812, in which Black Hawk's party had joined the British against the United States, peace and the treaty of 1804 were ratified by new treaties made separately with the chiefs of the two tribes, at Portage des Siouxs, September 13 and 14, 1815, and again afterward by another treaty of peace and friendship with the Sacs, made at Saint Louis, May 13, 1816. This last treaty was specially to ratify and confirm the treaty of 1804, and to bind the Indians to keep the

peace and return stolen property. It was signed by twenty-one chiefs and warriors of the Sac tribe, and Wilkie states, in his history of Davenport, by Black Hawk himself.*

By a subsequent treaty, dated August 24, 1816, the United States ceded a portion of the tract received from the Sacs and Foxes to the Ottowa, Chippewa, and Pottawatomie tribes in exchange for lands lying on the west shore of Lake Michigan, including the site of Chicago, and south of an east and west line from the south end of Lake Michigan to the Mississippi River. Afterward the ceded lands, the boundary-line of which it appears passed just north of the site of Black Hawk's village on Rock River, near Rock Island, were repurchased from the Ottowas, Chippewas, and Pottawatomies in two treaties, dated September 20, 1828, and July 29, 1829. In the latter treaty the United States agreed to pay the above tribes $16,000 in coin per annum, forever, for only a small portion of the lands originally purchased from the Sacs and Foxes for $2,000 per annum.

This appears to have caused Black Hawk's dissatisfaction and indignation, as exhibited in a council with General Gaines in the garrison on Rock Island, during the Black Hawk war in 1832.

Rock Island was not occupied by white men, and appears to have had no history until the breaking out of the war with Great Britain, in 1812. The Indians occupied it unmolested, and it was their favorite hunting and fishing ground, and its beautiful scenery and rich woods made it a favorite resort for feasts and for the performance of religious and other ceremonies. Reynolds, in his "Life and Times," gives a good description of the condition of the surrounding country just before the commencement of the war. He says:

> The territory that at this day embraces the populous State of Illinois presented at that early period a savage wilderness. The entire white population, French and Americans, amounted to about two thousand, or perhaps a small fraction more. The French creoles numbered about twelve hundred, and the Americans eight hundred or a thousand. This small white population was isolated by vast regions of wilderness, except on the west of the Mississippi. At this early period considerable colonies existed on the west side of the river, and extended much farther on the Mississippi than the settlements in Illinois. The lead-mines of the Spanish country attracted emigration, and the colonies extended back west from the river forty or more miles. These settlements were much larger than on the east side of the Mississippi; although they were in a foreign government, yet they gave strength and efficiency to the weaker colonies on the east side of the stream. The Indian tribes inhabiting the wilderness of that day, which is now comprised in the present limits of the State of Illinois, were numerous, warlike, and courageous. The savages at that day all possessed a wild and hostile spirit, that existed throughout the North American Indians. The wars had not then subdued their spirits. The Sac and Fox tribes were united, and formed at that day a large, brave, and powerful nation. Their chief residence was near Rock Island in the Mississippi, and throughout the country around that locality. The Winnebagoes resided on the upper part of Rock River, and west of Green Bay, northwest of Lake Michigan, and on and over the Wisconsin River. The Pottawatomies inhabited the region between Lake Michigan and the Illinois River, and down that river. The warlike and courageous small nation of the Kickapoo Indians dwelt in the prairies north and east of Springfield, and also in the region of country around Bloomington. The

* Wilkie spells Black Hawk's name as follows: Ma-ka-tai-me-she-kia-kiak. The pronunciation of this name is like that in the treaty, but the spelling of the latter is Mucke-ta-ma-che-ka-ka, and the translation "Black Sparrow Hawk." Western Annals, by John H. Perkins, in giving an account of the signing of this treaty of 1816, says, "A small party, led by the noted brave Black Hawk, even now refused to attend the treaty, proclaimed themselves to be British subjects, and went to Canada to receive presents."

Governor Reynolds, who seems to have been well informed respecting the matter, states positively that Black Hawk attended and signed the treaty, and that he afterward acknowledged it, saying "he touched the goose-quil." This, in connection with his conduct afterward, is inconsistent with Black Hawk's reputation for honesty.

Governor Ford spells Black Hawk's name as follows: "Mecata-Michicatah."

Kaskaskia Indians were *housed in* by the other tribes, to the country around about their ancient village of Kaskaskia. The Piankishaws were located in the southeastern section of the State, and inhabited the waters of the lower Wabash River on both sides of that stream. The most dense Indian population of the West was on the Illinois River and tributaries. Also on the Mississippi, near Rock Island, was a strong Indian population, but not equal to that on the Illinois River. It is impossible to be accurate in the estimation of the number of Indians who resided in the limits of the State at this early period. I presume it would range between 30,000 and 40,000 souls; and at this day not one exists in the State.

But a peep behind the curtain showed a weak and extended frontier from the site on the Mississippi where Alton now stands, down the river to the mouth of the Ohio, and up that stream and the Wabash to a point many miles above Vincennes, with a breadth of only a few miles at places. This exposed *outside* was three or four hundred miles long, and the interior and north inhabited by ten times as many hostile and enraged savages as there were whites in the country. The British garrisons on the north furnishing them with powder and lead and malicious counsels, and the United States leaving the country to its own defenses, presented a scene of distress that was oppressing.

In the spring of 1812 Captain Ramsey had a small company of regular troops stationed at Camp Russell, and they remained there only for a few months. These were the only regulars that saw Camp Russell during the war. In the commencement of the war the Indian traders reported the fact that Colonel Dixon, at Prairie du Chien, had engaged all the warriors of the north and around the prairie to descend the Mississippi and exterminate the settlements on both sides of the river. This was the plan of the campaign; but the English needed the Indians more in Canada, and they were brought to that section, and thereby our country was saved from a great effusion of blood. Many citizens who knew of the design of Dixon's warriors actually fortified their houses in the interior of the country, not far from Kaskaskia, and some removed their families to Kentucky. Dixon was a man of talents, and had, as an Indian trader, great influence with the Indians. He had the power to march the Indians to any point he pleased.

WAR OF 1812.

Throughout this war a portion of the Fox and Sac tribes at Rock Island remained hostile to the United States. The first incident of the war which affected the region in the vicinity of Rock Island was Governor Clark's expedition to Prairie du Chien. The following account of this expedition is taken from "Western Annals," by James H. Perkins:

About the first of May, Governor Clark fitted out five barges, with fifty regular troops and one hundred and forty volunteers, and left Saint Louis on an expedition to Prairie du Chien. On the 13th of June, Governor Clark, with several gentlemen who accompanied him, returned with one of the barges, having left the officers and troops to erect a fort and maintain the position.

No Indians molested the party till they reached Rock River, where they had a skirmish with some hostile Sauks. The Foxes resided at Dubuque, and professed to be peaceable, and promised to fight on the American side. Twenty days before the expedition reached Prairie du Chien the British trader Dixon left that place for Mackinac with eighty Winnebagoes, one hundred and twenty Follsavoine, and one hundred Sioux, probably as recruits for the British army along the lake country. He had gained information of the expedition of Governor Clark from his Indian spies, and had left Captain Deace with a body of Mackinac fencibles with orders to protect the place. The Sioux and Renards (Foxes) having refused to fight the Americans, Deace and his soldiers fled. The inhabitants also fled into the country, but returned as soon as they learned they were not to be injured. A temporary defense was immediately erected. Lieutenant Perkins, with sixty rank and file from Maj. Z. Taylor's company of the Seventh Regiment, took possession of the house occupied by the Mackinac Fur Company, in which they found nine or ten trunks of Dixon's property, with his papers and correspondence. A writer in the Gazette says:

"The farms of Prairie du Chien are in high cultivation. Between two and three hundred barrels of flour may be manufactured there this season, besides a vast quantity of corn. Two of the largest boats were left in command of Aid-de-Camp Kennerly and Captains Sullivan and Yeizer, whose united forces amount to one hundred and thirty-five men. The regulars, under command of Lieutenant Perkins, are stationed on shore, and are assisted by the volunteers in building the new fort."

This was called Fort Shelby. On his return the people of Saint Louis gave the governor a public dinner, and expressed their hearty gratulations for the success of the enterprise.

About the last of June, Capt. John Sullivan, with his company of militia and some

volunteers whose term of service had expired, returned from Prairie du Chien, and reported that the fort was finished, the boats well manned and barricaded; that the Indians were hovering around, and had taken prisoner a Frenchman while hunting his horses. The boats employed carried a six-pounder on the main deck, and several howitzers on the quarters and gangway. The men were protected by a musket-proof barricade. On the 6th of August, the Gazette (our authority in these details) states: "Just as we had put our paper to press, Lieutenant Perkins, with the troops which composed the garrison at Prairie du Chien, arrived here. Lieutenant Perkins fought the combined force of British and Indians three days and nights, until they approached the pickets by mining—provisions, amunition, and water expended—when he capitulated; the officers to keep their private property, and the whole not to serve until duly exchanged. Five of our troops were wounded during the siege."

In a letter from Captain Yeizer to Governor Clark, dated Saint Louis, July 28, 1814, we find the following facts: Captain Y. commanded one of the gunboats, a keel-boat fitted up in the manner heretofore described. On the 17th July, at half past one o'clock, from twelve to fifteen hundred British and Indians marched up in full view of the fort and the town, and demanded a surrender, "which demand was positively refused." They attacked Mr. Yeizer's boat at three o'clock, at long-shot distance. He returned the compliment by firing round-shot from his six-pounder, which made them change their position to a small mound nearer the boat. At the same time the Indians were firing from behind the houses and pickets. The boat then moved up the river to the head of the village, keeping up a constant discharge of fire-arms and artillery, which was answered by the enemy from the shore. The enemy's boats then crossed the river below, to attack the Americans from the opposite side of the river. A galling fire from opposite points was now kept up by the enemy on this boat, until the only alternative was left for Captain Yeizer to run the boat through the enemy's lines to a point five miles below, keeping up a brisk fire.

In the mean time another gunboat that lay on shore was fired on until it took fire and was burned. In Captain Yeizer's boat two officers and four privates were wounded and one private killed.

The British and Indians were commanded by Colonel McCay, (or Mackey,) who came in boats from Mackinac, by Green Bay and the Wisconsin, with artillery. Their report gives from one hundred and sixty to two hundred regulars and "Michigan fencibles," and about eight hundred Indians. They landed their artillery below the town and fort, and formed a battery, attacking the forts and the boats at the same time. After Captain Yeizer's boat had been driven from its anchorage, sappers and miners began operations in the bank, one hundred and fifty yards from the fort. Lieutenant Perkins held out while hope lasted. In the fort were George and James Kennerly, the former an aid to Governor Clark, the latter a lieutenant in the militia.

At this time General Benjamin Howard was in command of the military district extending from the interior of Indiana to the frontier of Mexico. After the return of Governor Clark from Prairie du Chien, and, as it appears, prior to the receipt of news of the engagement at that place, General Howard fitted out an expedition, under the command of Capt. John Campbell, First United States Infantry, to proceed to Prairie du Chien and strengthen the garrison at that place. The expedition consisted of forty two regulars, sixty-six rangers, and about twenty-one other persons, including boatmen, women, and the sutler's establishment. This expedition left Saint Louis early in July, 1814, and proceeded up the river, in three keel boats, as far as Rock Island, near which place it was attacked by the Indians and nearly destroyed. The following account of this expedition is taken from Governor Reynolds's "Life and Times:"

Lieutenant Campbell commanded the boat with the regulars, and Capt. Stephen Rector and Lieutenant Riggs the other two barges, manned by the rangers. The expedition reached Rock Island in peace, but the Sac and Fox Indians, in great numbers, swarmed around the boats, but still professed peace. The barge commanded by Rector was navigated mostly by the French of Cahokia, and were both good sailors and soldiers; and the same may be said of the company under Lieutenant Riggs, except as to the knowledge of navigation. The boats lay still all night, at or near the Sac and Fox villages at Rock Island, and the Indians were all night making hollow professions of friendship. Many of the French, after the battle, informed me that they knew the Indians would attack the boats, and accordingly they informed Lieutenant Campbell, but he disbelieved them. The French said that the Indians wanted them to leave the Americans and go home. They would squeeze the hands of the French and pull their

hands down the river, indicating to leave. The Indians disliked to fight their old friends, the French.

The fleet all set sail in the morning, and above Rock Island the wind blew so hard that Campbell's boat was forced on a lee-shore, and lodged on a small island near the mainland, known from this circumstance as "Campbell's Island." The Indians, commanded by Black Hawk, when the wind drifted the boat on shore, commenced an attack on it. The boats of Rector and Riggs were ahead, and could see the smoke of the fire-arms, but could not hear the report of the guns. They returned to assist Campbell, but the wind was so high that their barges were almost unmanageable. They anchored near Campbell, but could not reach him, the storm raged so severely.

When Campbell's boat was driven ashore by the wind, he placed out sentinels, and the men commenced cooking their breakfast; but the enemy in hundreds rushed on them, killing many on the spot, and the rest took refuge in the boat. Hundreds and hundreds of the warriors were on and around the boat, and at last set it on fire. Campbell's boat was burning, and the bottom covered with the dead, the wounded, and blood. They had almost ceased firing when Rector and his brave men most nobly came to the rescue. Campbell himself lay wounded on his back in the bottom of his boat, and many of his men dead and dying around him. Riggs's boat was well fortified, but his men were inexperienced sailors. Rector and company could not remain inactive spectators of the destruction of Campbell and men, but in a tempest of wind raised their anchor in the face of almost a thousand Indians, and periled their lives in the rescue of Campbell. No act of noble daring and bravery surpassed the rescue of Campbell during the war in the West. The rangers under Rector were mostly Frenchmen, and were well acquainted with the management of a boat in such a crisis. Rector and his men were governed by the high and ennobling principles of chivalry and patriotism. Rector's boat was lightened by casting overboard quantities of provisions, and then many of the crew actually got out of the boat into the water, leaving the vessel between them and the fire of the enemy, and pushed their boat against the fire of the warriors to Campbell's boat, which was in possession of the Indians. This was a most hazardous exploit for forty men forcing their barge to a burning boat in possession of the enemy, nearly a thousand strong, and taking from it the wounded and living soldiers, together with their commander.

A salt-water sailor by the name of Hoadley did gallant service in this daring enterprise by his superior knowledge of the management of a vessel. Rector took all the live men from Campbell's boat into his; and his men, in the water, hauled their own boat out into the stream. The Indians feasted on the abandoned boat of Campbell. Rector had his boat crowded with the wounded and dying; but rowed night and day until they reached Saint Louis. It was supposed the boat of Riggs was captured by the enemy; but the vessel was strongly fortified, so that it lay as it were in the hands of the Indians for several hours, the enemy having possession of the outside and the whites of the inside; but the wind in the evening subsided and Riggs got his boat off without losing many men. It was a general jubilee and rejoicing when Riggs arrived at Saint Louis. The hearts of the people swelled with patriotic joy to know that the lives of so many brave soldiers were saved by the courage and energies of Rector, Riggs, and their troops. I saw the soldiers on their return to Saint Louis, and the sight was distressing. Those who were not wounded were worn down to skeletons by labor and fatigue.

The National Intelligencer of August, 1814, states the number of killed and wounded in this engagement to have been thirty-six. Captain Campbell and Dr. Abram Steward, surgeon's mate, were also wounded; the former seriously. After this disaster and the return of the survivors to Saint Louis, another and larger expedition was fitted out; the object of which was to punish the Indians at Rock Island, and to establish and maintain a fort at or near that place. The detachment was under the command of Bvt. Maj. Zachary Taylor, Seventh United States Infantry, (afterward President of the United States,) and consisted of 334 officers and men, (regulars, militia, and rangers.) There were only forty of the regular troops, and it is presumed that these belonged to the Seventh United States Infantry.

The following official report of Major Taylor's engagement with the British and Indians at the mouth of Rock River, near Rock Island, is not found in any history of Illinois at my command, and, as it is particularly interesting in connection with Rock Island history, it is copied here in full.

SKIRMISH AT MOUTH OF ROCK RIVER.

Letter from Major Taylor to General Howard, dated Fort Madison, September 6, 1814:

SIR: In obedience to your orders, I left for Fort Independence on the 2d ult., and reached Rock River, our place of destination, on the evening of the 4th inst., without meeting a single Indian, or any occurrence worthy of relation. On my arrival at the mouth of Rock River, the Indians began to make their appearance in considerable numbers; running up the Mississippi to the upper village, and crossing the river below us. After passing Rock River, which is very small at the mouth, from an attentive and careful examination as I proceeded up the Mississippi, I was confident it was impossible for us to enter its mouth with our large boats. Immediately opposite its mouth a large island commences, which, together with the western shore of the Mississippi, was covered with a considerable number of horses, which were doubtless placed n those situations in order to draw small detachments on shore. But in this they were disappointed, and I determined to alter the plan which you have suggested—which was to pass the different villages as if the object of the expedition was Prairie du Chien—for several reasons: First, that I might have an opportunity of viewing the situation of the ground to enable me to select such a landing as would bring our artillery to bear on the villages with the greatest advantage. I was likewise in hopes a party would approach us with a flag, from which I expected to learn the situation of affairs at the Prairie, and ascertain in some measure their numbers and perhaps bring them to a council, when I should have been able to have retaliated on them for their repeated acts of treachery; or, if they were determined to attack us, I was in hopes to draw them some distance from their towns toward the rapids, run down in the night and destroy them before they could return to their defense. But in this I was disappointed—the wind which had been in our favor began to shift about at the time we passed the mouth of Rock River; and by the time we reached the head of the island, which is about a mile and a half long, it blew a perfect hurricane, quarterly down the river, and it was with difficulty we made land at a small island containing six or eight acres covered with willows, near the middle of the river, and about sixty yards from the upper end of the island. In this situation I determined to remain during the night, if the storm continued, as I knew the anchors of several of the boats in that event would not hold them and there was a great probability of their being drifted on sand-bars, of which the river is full in this place, which would have exposed the men very much in getting them off, even if they could have prevented their filling with water. It was about 4 o'clock in the evening when we were compelled to land; and large parties of Indians were on each side of the river, as well as crossing in different directions in canoes, but not a gun was fired from either side. The wind continued to blow the whole night with violence, accompanied with some rain; which induced me to order the sentinels to be brought in and placed in the bow of each boat. About daylight Captain Whitesides's boat was fired on at the distance of about fifteen paces, and a corporal who was on the outside of the boat was mortally wounded. My orders were if a boat was fired on to return it, but not a man to leave the boat without positive orders from myself. So soon as it got perfectly light, as the enemy continued about the boat, I determined to drum them from the island, let their numbers be what they might, provided we were able to do so. I then assigned to each boat a proper guard, formed the troops for action, and pushed through the willows to the opposite shore; but those fellows who had the boldness to fire on the boats cleared themselves as soon as the troops were formed, by wading from the island we were encamped on to the one just below us. Captain Whitesides, who was on the left, was able to give them a warm fire as they reached the island they had retreated to. They returned the fire for a few moments, when they retreated. In this affair we had two men badly wounded. When Captain Whitesides commenced the fire, I ordered Captain Rector to drop down with his boat to ground and to rake the island below with artillery, and to fire on every canoe he should discover passing from one shore to the other which should come within reach. In this situation he remained about one hour, and no Indians making their appearance, he determined to drop down the island about sixty yards and destroy several canoes that were laying to shore. This he effected, and just on setting his men on board, the British commenced a fire on our boats with a six, a four, and two swivels, from behind a knoll, that completely covered them. The boats were entirely exposed to the artillery, which was distant about three hundred and fifty paces from us. So soon as the first gun fired, I ordered a six-pounder to be brought out and placed, but, on recollecting a moment, I found the boat would be sunk before any impression could be made on them by our cannon, as they were completely under cover, and had already brought their guns to bear on our boats, for the round-shot from their six passed through Lieutenant Hempstead's boat and shattered her considerably. I then ordered the boats to drop down, which was done in order

and conducted with the greatest coolness by every officer, although exposed to a constant fire from their artillery for more than half a mile. So soon as they commenced firing from their artillery, the Indians raised the yell and commenced firing on us in every direction, whether they were able to do us any damage or not, from each side of the river. Captain Rector, who was laying to the shore of the island, was attacked the instant the first gun was fired, by a very large party, and in a close and well-contested contest of about fifteen minutes they drove them, after giving three rounds of grape from his three-pounder. Captain Whitesides, who was nearest to Captain Rector, dropped down and anchored nigh him, and gave the enemy several fires with his swivel; but the wind was so hard down stream as to drift his anchor. Captain Rector at that moment got his boat off, and we were then exposed to the fire of the Indians for two miles, which we returned with interest from our small-arms and small pieces of artillery, whenever we could get them to bear. I was compelled to drop down about three miles before a proper place presented itself for landing, as but few of the boats had anchors sufficient to stop them in the river. Here I halted for the purpose of having the wounded attended and some of the boats repaired, as some of them had been injured by the enemy's artillery. They followed us in their boats until we halted on a small prairie and prepared for action, when they returned in as great a hurry as they followed us.

I then collected the officers together and put the following questions to them: Are we able, 334 effective men—officers, non-commissioned officers, and privates—to fight the enemy with any prospect of success and effect, which is to destroy their villages and corn? They were of opinion the enemy was at least three men to one, and that it was not practicable to effect either object. I then determined to drop down the river to the Lemoine without delay, as some of the ranging officers informed me their men were short of provisions, and execute the principal object of the expedition, in erecting a fort to command the river. This shall be effected as soon as practicable with the means in my power; and should the enemy attempt to descend the river in force before the fort can be completed, every foot of the way from the fort to the settlement shall be contested.

In the affair at Rock River I had eleven men badly wounded, three mortally, of whom one has since died. I am much indebted to the officers for their prompt obedience to orders, nor do I believe a braver set of men could have been collected than those who compose this detachment. But, sir, I conceive it would have been madness in me, as well as a direct violation of my orders, to have risked the detachment without a prospect of success.

I believe I should have been fully able to have accomplished your views if the enemy had not been supplied with artillery, and so advantageously posted as to render it impossible for us to have dislodged him without imminent danger of the loss of the whole detachment.

ZA. TAYLOR,
Brevet Major, Commanding Detachment.

The following account of this expedition is taken from Governor Reynolds's "Life and Times:"

Nothing uncommon occurred until they reached Rock Island, where they met British soldiers, cannon, and swarms of Indians.

The English had captured our garrison at Prairie du Chien, and had the whole country in possession north of the settlements near the present city of Alton.

Our white enemy was at Rock Island, with many regulars, six pieces of cannon, and hordes of Indian warriors. Major Taylor, with his usual sound judgment, anchored his fleet out in the Mississippi, about one-half mile above the mouth of Rock River, and not far from Three Willow Islands.* It was supposed that the English had ordered the Indians to occupy these islands in great numbers in the night, as they swarmed with the red warriors at daylight. The English had, in the night, planted cannon in battery at the edge of the water, so as to destroy our boats in the morning. It was the English calculation that the cannon would destroy our boats, and the men would have to swim to the islands, where the Indians would kill them. It is almost impossible to circumvent the Americans. Taylor ordered all his forces, except twenty men on each boat, to proceed to the islands and destroy the Indian warriors on them. This order was executed with great vigor and efficiency, and the Indians were either killed or drove down to the lower island; but, in the mean time, the British cannon opened a tremendous fire on our boats, that caused the soldiers to rush back to the boats to save them from the cannon-balls which were piercing them in every direction. British officers were mounted on horseback, giving command to the cannonades, and many regulars and hundreds of Indians obeying. The boats were unable to resist the cannon, and almost every shot told on them. In the battle some Indian canoes were seen on the

*About three (3) miles below Rock Island.

lower island, and Captain Rector was ordered, with some men, to scour the island. He did so, and drove the Indians back into the willows; but the enemy re-enforced, and in turn drove Rector back to the sand-beach again. In this sortie from his boat, Rector was elegantly dressed in military costume, with a towering feather in his cap, and a sword drawn, leading his men to the charge. In this exposed situation, with hundreds of guns fired at him, he moved on undaunted, as if he were in his mess-room with his comrades. The Rector family never knew what fear was. The boats under Taylor were ordered to retreat down the river; but just as Rector's boat got under way it grounded and stuck fast. The Indians surrounded it, and it was with the utmost hard fighting they were kept out. All the boats had left, except Capt. Samuel Whitesides's, who saw the imminent danger of Rector, and with true courage and kindness of heart, returned to save his brother soldiers. If Whitesides had not returned, Rector and all his men were doomed to destruction. Rector's boat being saved, all descended the river until they were out of the reach of the cannon, when Major Taylor called a council of his officers.

It was ascertained that there were more than a thousand Indians at and near Rock Island, and a detachment of British regulars, with six field-pieces; and the effective American soldiers were only 334 in number. This showed the force of the enemy to be more than three to one over the Americans. Under all circumstances it was considered imprudent and improper to attack such superior forces, and the whole fleet descended the river to the site where Warsaw now stands. At this point Fort Edwards was built, and Fort Johnson, a few miles above, was burned. After the erection of Fort Edwards, the troops remained three or four weeks; but the major part of them descended the river to Saint Louis, and were discharged the 18th October, 1814.

Thus ended this expedition, which pretty much closed the war in the West. Scarcely any further Indian depredations were committed, and the troops were generally disbanded. On the 24th December, 1814, peace was concluded at Ghent, in Europe; but the act was not known for some months thereafter.

I saw in the harbor of Saint Louis the boats that were in Taylor's battle at Rock Island, and they were riddled with cannon-balls. I think the balls were made of lead; at any rate, they pierced the boats considerably.

After the war was closed the treaties of peace made with the Sacs and Foxes, already mentioned, were signed at Portage des Sioux on the 13th and 14th of September, 1815. From the wording of the first of these, and statements made by the chiefs, it appears that a portion of the Sac tribe had endeavored faithfully to carry out the treaty of 1804; that they had not engaged in the war against the United States, but that they had separated from Black Hawk and his party, and had removed to the Missouri River.

ESTABLISHMENT OF A MILITARY POST ON ROCK ISLAND AND FORT ARMSTRONG BUILT.*

In September, 1815, the Eighth United States Infantry, under the command of Col. R. C. Nichols, colonel of the regiment, was sent up the river from Saint Louis to establish a fort at or near Rock Island. The object of the expedition was to occupy the country at the mouth of the Rock River, protect anticipated settlers, control the Sac and Fox tribes of Indians, and to open and protect a line of communication via the river to Prairie du Chien and other posts which were to be established farther up the river. From some correspondence, and perhaps also from the hostility or lack of friendliness shown by Black Hawk and his party after the war in refusing to attend or sign the treaty at Portage des Sioux, it was thought these Indians would remain unfriendly and endanger the supplying of the posts on the Upper Mississippi via the river. At that time the Army was supplied [with provisions by contractors

* The following account of the occupation of Rock Island by United States troops and building of Fort Armstrong is taken principally from official records; from a sketch of Colonel Davenport's life, written by F. B. Wilkie; from newspaper articles written principally by Hon. Bailey Davenport, son of Colonel Davenport, and from information obtained from Mr. Davenport and others, and from Judge Spencer's reminiscences of a "Pioneer Life," and other books.

directly, and not through a commissary department as done now. Mr. George Davenport* accompanied the expedition as contractor's agent, and had his supplies in light keel-boats. The troops were also transported in keel-boats.† The expedition reached the mouth of the Des Moines River, about 140 miles below Rock Island, in November, and was there stopped by the ice and went into winter quarters where Major Taylor and his command had wintered on their return from Rock Island in the preceding year.‡

The troops constructed huts or wigwams to protect them from the cold during the winter, and the post was named "Cantonment Davis." Fort Edwards was built at this place, near where Warsaw now stands, in the following year.

During the winter Colonel Nichols was placed in arrest and sent to Nashville, Tenn., and the command devolved upon Bvt. Lieut. Col. W. Lawrence, major of the regiment.

In the following April, 1816, Bvt. Brig. Gen. Thomas A. Smith, colonel of the rifle regiment, arrived at the cantonment with his regiment, took command of the expedition, and proceeded up the river. He arrived at Rock Island early in May, and after examining the country in the vicinity of the mouth of Rock River,§ fixed upon the foot or west‖ end of Rock Island as the site of the fort which was to built. The troops were first landed on the island on the 10th of May, 1816. They went into camp and at once commenced cutting timber for building store-houses. At that time the west end of the island, which is now bare, was covered with a heavy growth of oak, black walnut, elm, and bass-wood.

On the day after landing General Smith sent messages to the Sacs and Foxes to meet him in council, but they refused to come. There were supposed to be living in the vicinity of Rock Island at that time about 11,000 Indians belonging to these two tribes.¶

General Smith remained at Rock Island only long enough to construct abatis for the protection of the troops from the Indians, and then proceeded up the river with the whole of the rifle regiment to re-occupy the fort at Prairie du Chien, and establish a fort (Fort Saint Peters, afterward Fort Snelling) in the vicinity of Saint Anthony's Falls.

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*Mr. Davenport was widely known as Col. George Davenport. He was the first white settler at or in the vicinity of Rock Island, and afterward became Indian agent for the Government and received a grant of land on the island. His remarkable career is intimately connected with the history of Rock Island.

†Keel-boats were ordinary barges or scows, provided with a keel to permit the use of a mast and sail, and were much used on western rivers in early times for transportation purposes. They were propelled by sails when the wind was favorable, and at other times by poles, oars, and by men or horses walking on the shore and towing them.

‡The following incident of this expedition is related by Hon. B. Davenport: "One morning during a thick fog the boats were anchored in an eddy of the river for breakfast; while seated in the boats at breakfast, two of the officers, Second Lieutenants Bennet Riley and T. F. Smith, of the rifle regiment, found that they had different opinions respecting the direction of the current of the river, and entered into a violent controversy on the subject. Finding that this would not make the river flow two ways, they chose their seconds, took pistols, left their breakfast, and went ashore to fight it out and settle the matter. After exchanging a few shots, neither having been hit, and having discovered a higher respect for each other's opinions, as is usual when looked at through the pistol medium, shook hands and went back to their breakfast." Mr. Davenport adds there were other duels before they reached their winter quarters.

‖The course of the Mississippi past Rock Island is nearly due west.

§The mouth of Rock River is about five miles below Rock Island.

¶Their largest village was on Rock River, about five miles from Rock Island, just below "Black Hawk's Tower." They had other villages on the banks of the Mississippi, on the present sites of the cities of Davenport and Rock Island, and also on the site of Princeton, Iowa.

The Eighth Infantry, under the command of Colonel Lawrence, was left at Rock Island, and Colonel Lawrence at once commenced the construction of the fort, which was named Fort Armstrong, in honor of the Secretary of War. The interior of the fort was 400 feet square. The lower half of the walls was of stone, and the upper half of hewn timber. The timber and stone were procured on the island. At three of the angles—the northeast, southeast, and southwest—block-houses were built, and these were provided with cannon. One side of the square was occupied by the barracks and other buildings. These were built of hewn timber, with roofs sloping inward as a protection against their being fired by the Indians, and that they might not furnish a safe lodging-place for the enemy in an attack. The fort was placed on the extreme northwest angle of the island. Its northwest corner was about 200 feet from the present location of the island end of the bridge.

Governor Ford, in his History of Illinois, gives the following description of Fort Armstrong as it appeared in 1831:

> Fort Armstrong was built upon a rocky cliff on the lower point of an island near the center of the river, a little way above; the shores on each side formed of gentle slopes of prairie, extending back to bluffs of considerable height, made it one of the most picturesque scenes in the western country. The river here is a beautiful sheet of clear, swift-running water, about three-quarters of a mile wide; its banks on both sides were uninhabited, except by Indians, from the lower rapids to the fort; and the voyager up-stream, after several days' solitary progress through a wilderness country on its borders, came suddenly in sight of the whitewashed walls and towers of the fort, perched upon a rock, surrounded by the grandeur and beauty of nature, which, at a distance, gave it the appearance of one of those enchanted castles in an uninhabited desert, so well described in the Arabian Nights' Entertainments.

After General Smith had gone up the river and the troops had finished the abatis and commenced getting out timber for the fort, the Indians pretended to be more friendly, and began visiting the island in their canoes in great numbers. The following incident is taken from a letter written by the Hon. B. Davenport and published in the Rock Island Argus:

> One day a small party came over to dance, and after the dance the colonel in command gave them presents.
>
> In a few days after, and while a large number of the soldiers were out cutting timber, a large party of warriors, headed by the Ne-ka-le-quat, came over in canoes and landed on the north side of the island, and danced up to the entrance of the encampment, and wanted to enter and dance in front of the commander's tent. About the same time a large party of warriors was discovered approaching over the ridge from the south side of the island, headed by Keokuk. The colonel immediately ordered the bugle sounded to recall the soldiers from the woods, and had all under arms, (about 600,) and the cannon run out in front of the entrance, ready to fire. The Indians were ordered not to approach any nearer.
>
> The colonel, taking the alarm before Keokuk's party got near enough to rush in, saved the encampment from surprise and massacre.

The Indians evidently knew that the erection of the fort was intended to compel a compliance on their part with the treaties which had been made, and that, when white settlers came, they might have to leave their homes. Speaking of this, years afterward, Black Hawk said:

> We did not, however, try to prevent their building the fort on the island, but we were very sorry, as this was the best island on the Mississippi, and had long been the resort of our young people during the summer. It was our garden, (like the white people have near their big villages,) which supplied us with strawberries, blackberries, plums, apples, and nuts of various kinds; and its waters supplied us with pure fish, being situated in the rapids of the river. In my early life I spent many happy days on this island. A good spirit had care of it, who lived in a cave in the rocks immediately under the place where the fort now stands, and has often been seen by our people. He was white, with large wings like a *swan's*, but ten times larger. We were particular not to make much noise in that part of the island which he inhabited, for fear of disturbing him. But the noise of the fort has since driven him away, and no *doubt a bad* spirit has taken his place.

The cave referred to was in the face of the limestone bluff at the northwest corner of the island. At high water the floor of the cave was covered and boats could enter. This cave was closed by building the abutment of the bridge across its entrance in 1870.

After the completion of Fort Armstrong, in 1817, there is nothing of much importance connected with Rock Island to be recorded till the breaking out of the Black Hawk war in 1831.

The officers and troops stationed at Fort Armstrong from August, 1819, (first return on file,) until abandoned, May 4, 1836, were as follows:

Commanding officer.	Date.		Garrison.
	From—	To—	
Capt. M. Marston, Fifth Infantry...	Aug. —, 1819	June —, 1821	Company F, Fifth Infantry.
Capt. S. Burbank, Fifth Infantry...	June —, 1821	June —, 1823	Company D, Fifth Infantry.
Maj. J. H. Vose, Fifth Infantry.....	June —, 1823	June 4, 1825	Companies D and F, Fifth Infantry.
Capt. S. Burbank, Fifth Infantry...	June 4, 1825	May 21, 1826	Companies D and F, Fifth Infantry.
Maj. J. H. Vose, Fifth Infantry.....	May 21, 1826	Oct. 9, 1827	Companies E and H, Fifth Infantry.
Capt. J. Plympton, Fifth Infantry..	Oct. 9, 1827	Apr. 28, 1828	Companies E and H, Fifth Infantry.
Maj. S. Burbank, Fifth Infantry....	Apr. 28, 1828	Apr. 30, 1828	Companies E and H, Fifth Infantry.
Capt. J. Green, Third Infantry	Apr. 30, 1828	June —, 1828	Companies C and G, Third Infantry.
Capt. J. S. Nelson, Third Infantry..	June —, 1828	Aug. 13, 1828	Companies C and G, Third Infantry.
Capt. J. Green, Third Infantry	Aug. 13, 1828	July 27, 1830	Companies C and G, Third Infantry.
Capt. John Bliss, Third Infantry...	July 27, 1830	July 26, 1831	Companies D and H, Third Infantry.
Capt. T. J. Beall, First Infantry....	July 26, 1831	Sept. 2, 1831	Companies C and K, First Infantry.
Maj. John Bliss, First Infantry	Sept. 2, 1831	May 4, 1832	Companies C and K, First Infantry.
Capt. T. J. Beall, First Infantry....	May 4, 1832	Oct. 26, 1832	Companies C and K, First Infantry.
Lieut. A. S. Miller, First Infantry ..	Oct. 26, 1832	Dec. 2, 1832	Companies C and K, First Infantry.
Capt. T. F. Smith, First Infantry...	Dec. 2, 1832	June 8, 1833	Companies G and K, First Infantry.
Lieut. Col. William Davenport, First Infantry.	June 8, 1833	May 4, 1836	Companies G and K, First Infantry.

An incident related by Judge Spencer, one of the first settlers at Rock Island, portrays the extreme isolation of Fort Armstrong and other western posts in early times. He says:

> At this time (1828) they had only an occasional mail here, which was got by sending two soldiers on foot to Galena.* Soon after I came, having business at Galena, and the officers of the garrison being anxious to hear who had been elected President in November, it being now the 20th of December, it was arranged that I should carry the mail to Galena and bring one in return, for which I was to receive $5.

Judge Spencer made the whole trip alone on foot, in the extreme cold weather of winter, and brought back to the garrison the news of General Jackson's election.

White settlers appear to have first located in the vicinity of Rock Island in about 1828. Judge Spencer states the number of settlers on the main-land in the spring of 1828 to have been only nine men, some of whom had families.

At this time it was the habit of the Indians to leave their villages for several months in each year, and while they were absent the white settlers moved in and took possession. This created discontent and hostility among the Indians when they returned, and as the number of settlers increased the feeling became stronger. The commanding officers at Fort Armstrong and the Indian agent on the island, Colonel Davenport, frequently required and urged the Indians to give up their villages and lands and move across the Mississippi, in accordance with their treaties; but Black Hawk and his party of the Sacs, sometimes called the "British party" or "British band," because of their adherence to the English, refused to go.

* About 100 miles from Rock Island. Galena had at that time acquired some importance on account of its lead-mines.

THE BLACK HAWK WAR.

The history of the Black Hawk war has been repeatedly written and is well known. Only a short summary of such of its events as relate particularly to Rock Island will be given. In 1828, Keokuk, the head chief of the Foxes, and his tribe, in accordance with the treaties they had made with the United States, moved west of the Mississippi and established themselves on the Iowa River. Between this time and 1831 the number of white settlers on the main-land in the vicinity of Rock Island rapidly increased. The lands, including the site of the Sac village, were surveyed and sold to the settlers by the United States, but Black Hawk and his party of the Sacs called the British band, which numbered about five hundred warriors, still remained in their village and refused to leave. Complaints from the settlers of depredations by the Indians were frequent, till finally, in the spring of 1831, Black Hawk warned the settlers that they must leave. It was also feared that some neighboring tribes of Indians, the Kickapoos, Pottawatomies, and Winnebagoes, would join Black Hawk in an attack on the whites. The settlers sent petitions for protection to the military authorities at Rock Island and Saint Louis and to the governor of Illinois. The latter, Governor Reynolds, promptly assembled about 1,600 mounted volunteers at Beardstown, 90 miles from Rock Island, and marched with them to Rock Island. General Gaines, who was in Saint Louis, went at once to Rock Island, taking the Sixth United States Infantry, which was at Jefferson Barracks, with him. The settlers were all moved to the island, and General Gaines sent for Black Hawk for a talk. The following account of this meeting, which is given by Judge Spencer, of Rock Island, who was present, and was well acquainted with Black Hawk, is interesting:

> Keokuk and some of his friends came up from their village on the Iowa River, and came onto the island. General Gaines, the officers of the Sixth regiment, the officers of the garrison, with the citizens, and Keokuk and his friends met in the council-house. Black Hawk, with seventy-five to one hundred warriors, nicely dressed and painted, drew near. When within about one hundred yards of the council-house they commenced singing in a very loud voice, which seemed to alarm Keokuk and party so much that they left in great haste. Those who understood the Indians best thought from the singing and the manner of the Indians that there would be a general massacre. A man that always accompanied Black Hawk, as they entered the council-house, commenced singing in a very boisterous manner, and gesticulating as though he was very angry, speaking very rapidly. General Gaines spoke to him very quietly of the sale of their lands. The Indian said the land had never been sold. General Gaines then called for the reading of the treaty, which seemed to enrage him still more. He said, "The white people speak from a paper; but," he added, striking his hand upon his breast, "the Indian always speaks from the heart." The first point Black Hawk tried to make when he spoke was that "the land had not been sold, as the men who went to Saint Louis had no authority to sell, having been sent on other business." By this time we began to think Black Hawk was pretty nearly right. The second point he made was, "If it was sold, they had got nothing for it." He said, over and over again, "If a small part of the land was worth $16,000 a year forever, all of it must be worth more than $2,000." When the general pressed an answer about his leaving, he said all the time "he would not fight and he would not leave, but if our people came to drive him off, he would sit down in his wigwam, and they might do what they pleased with him; for himself, he would do nothing." General Gaines interpreted his talk to mean that he would fight.

General Gaines's command was joined by Governor Reynolds with his volunteer troops near the mouth of Rock River on the evening of the 19th of June, 1831, and the next morning the combined forces moved upon the Sac village. They found, however, that Black Hawk and all his people had left. They had crossed the Mississippi and camped about twelve miles below Rock Island. On the 30th of June, Black

Hawk came to Rock Island with twenty-seven of his chiefs and warriors, and signed a treaty of peace with General Gaines and the governor of Illinois, acting in behalf of the United States. In this treaty he pledged himself not to return again to the east side of the river or to engage again in hostilities against the United States.

Governor Reynolds's volunteers were then disbanded and went home. Corn and provisions were distributed to the Indians by General Gaines. During the winter of 1831–'32 it became evident that Black Hawk would not keep the treaty which he had signed the summer before. About the 8th of April he crossed the Mississippi at Burlington, and moved up the left bank of the river, with about 500 warriors and his women and children, with the intention of driving out the settlers and re-occupying his old village. He expected assistance from the Winnebagoes and other Indians on Rock River farther north. He had also made strenuous efforts during the winter to induce Keokuk to join him in his attempt, but without success. As soon as news was received that this move of Black Hawk's was anticipated, General Atkinson, colonel of the Sixth Infantry, left Jefferson Barracks with the First Infantry and went to Rock Island. Lieut. Col. Zachary Taylor (afterward President of the United States) was in command of the regiment, and Lieut. Jefferson Davis (afterward president of the so-called Confederate States of America) and Capt. William S. Harney (afterward General Harney) were members of the regiment and served through the campaign.

During the month of April Governor Reynolds assembled about 2,000 volunteers at Beardstown, and marched to Yellow Banks, on the Mississippi, fifty miles below Rock Island. He then marched up to the mouth of Rock River, where he was joined by General Atkinson and the regular troops. The volunteers were commanded by General Whiteside, and Abraham Lincoln (afterward President of the United States) held the rank of captain in this command and fought throughout the campaign.

On arriving at the mouth of Rock River the Indians had gone up that river till they were about opposite Rock Island. Then Black Hawk sent his women and children and baggage on up the river in canoes, and he and his warriors ventured a bold attempt to capture Fort Armstrong. At this time the garrison consisted of only two companies of infantry, partly full, and mustering altogether not over 80 fighting men. Black Hawk brought his warriors by night from Rock River, a distance of five miles, through the woods, over the bluffs, to the Mississippi, and crossed to Rock Island. A terrible snow-storm is said to have prevented an attack on the fort that night, and before morning general Atkinson arrived with the Sixth Infantry, and probably saved the garrison from massacre. It is more reasonable to suppose that Black Hawk had no hope of getting into the fort except by stealth or stratagem, and in this the snow-storm would have aided him. He probably found out during the night that General Atkinson was at hand with re-enforcements, and that, even if he succeeded in capturing the fort, he and his whole band would eventually be taken prisoners in the fort. The Indians withdrew during the night and followed their people up Rock River. General Atkinson at once joined General Whiteside and his volunteers on Rock River and started in pursuit of the Indians. After much hard fighting in the months of May, June, July, and August, in which the principal battles were Stillman's Run (May 15) and Bad Axe, on the Mississippi, (August 2,) nearly the whole of Black Hawk's band was destroyed, and Black Hawk himself, his son, Seoskuk, and other chiefs, were made prisoners and brought to Rock Island. They were afterward taken to Washington and other eastern cities.

On the breaking out of hostilities, General Scott had been sent from the East with troops to direct the campaign. He made a rapid movement by way of the great lakes, and arrived at Prairie du Chien a few days after the battle of Bad Axe. He then went down the Mississippi to Rock Island.

A virulent type of Asiatic cholera had broken out among the troops while on transports on the lakes, and was brought with them to Rock Island. It raged in its worst form in the large camp of jaded troops collected on the island after the campaign, and was only broken up by distributing the troops in small camps on the bluffs along the west bank of the river. Several medical officers died, and General Scott, in a letter written after the war, ascribed the saving of the army from decimation by the scourge to the efforts of his chief medical officer, Surgeon C. A. Finley, afterward Surgeon-General during the late war of the rebellion.

The Government took much pains to secure for Black Hawk a kind reception by the Indians upon his return from his eastern tour.

The accounts of this meeting between Black Hawk, Keokuk, and other chiefs at Rock Island are very affecting. Black Hawk then established himself with a remnant of his tribe on Des Moines River in Iowa, where he died in 1838.

Tradition states that the Sacs and Foxes came from the vicinity of Montreal, Canada, before the year 1700, and that they had lived in their villages at or near Rock Island fully 150 years. Their affection for these villages was like that of the Jews for their city of Jerusalem.

After the close of the Black Hawk war, there is no record of further hostilities with the Indians at Rock Island. A garrison was maintained at Fort Armstrong till the 4th of May, 1836, when the fort was evacuated and the troops were sent to Fort Snelling. Lieut. Col. Wm. Davenport of the First United States Infantry, was in command of the fort at the time it was evacuated, and he left Lieut. John Beach, United States Infantry, in charge, with a few men to take care of property. But the fort was never regarrisoned, and in the following November (1836) Lieutenant Beach was ordered away, and the property that had been left was removed. General Street, Indian agent, then had charge of the island until 1838, when Col. George Davenport was appointed Indian agent, and remained in charge till 1840.

In 1840, some of the buildings at Fort Armstrong were repaired and an ordnance-depot was established at the fort by the United States Ordnance Department. Capt. W. R. Shoemaker, ordnance-storekeeper, was placed in charge of the depot, and also had charge of the island until 1845. The depot was then broken up and the stores were removed to the Saint Louis arsenal.

From 1845 till the act for establishing the Rock Island arsenal was passed, in 1862, the island was in charge of a civil agent or custodian, employed by the War Department, and never passed out of the control of that Department.

Mr. Thomas L. Drum, of Rock Island City, was custodian from 1845 to 1853; Mr. J. B. Danforth, of Rock Island, from 1854 to 1857, and Mr. H. Y. Slaymaker from 1857 to 1863. For a short time in 1853 and 1854 Ordnance-Sergeant Cummings was in charge.

The history of this period, from 1845 to 1863, while the island was in charge of a civil agent, is full of persistent and protracted efforts on the part of squatters, manufacturing, railroad, water-power companies, and others, to procure, by pre-emption, lease, purchase, or cession, a title to lands on the island. These efforts are interesting in themselves, but are particularly so in connection with the present use of the island, because

they show the high estimate placed upon it and its water-power by all acquainted with it, and also because they frequently show, in correspondence, reports, and debates in Congress, the fixed opinion of many eminent men that the island must under no circumstances be allowed to pass out of the control of the General Government, and that it would eventually become the site of a great armory and arsenal for the Mississippi Valley.

The following abstract taken from the books of the General Land-Office, Washington, and furnished by the Commissioner, shows all the action taken by the Government respecting the island, of which that office has record, and is useful for reference in all that follows:

GENERAL LAND-OFFICE, *September* 20, 1852.

SIR: Agreeable to instructions, I have the honor to transmit herewith in reference to Rock Island, Illinois, * * * with my report upon the same.

On the 2d of March, 1825, the Secretary of War informed the Commissioner of the General Land-Office that Rock Island was necessary for military purposes, and directed that it be reserved from sale.

In accordance with such instructions, the Commissioner, on the 8th of April, 1825, advised the register of the land-office at Springfield, Illinois, that the island was thereafter to be considered as reserved for military purposes.

Again, on the 11th of September, 1835, the Secretary of War requested that instructions might be given to the register and receiver of the land-office at Galena, Illinois, not to offer at public sale, nor grant pre-emption rights to any of the public land on Rock Island, so long as the position is required for military purposes.

In compliance with this request, instructions were issued by the Commissioner to the register and receiver at Galena, on the 15th of September, 1835, directing them to reserve Rock Island from any public sale, and stating that no pre-emption claim to land on said island, by virtue of the act of June 19, 1834, could be recognized.

On the 23d of April, 1836, Major-General Jesup informed the Commissioner of the General Land-Office that Fort Armstrong, on Rock Island, was occupied in August, 1815; that he thought it unnecessary to trace the records further back, but believed the fort was established during the war with Great Britain, when General Armstrong was Secretary of War.

On the 20th of October, 1838, the Secretary of War informed the Commissioner of the General Land-Office that individuals were intruding on the military reservation on Rock Island, and asked for an accurate plat of the reservation, that instructions might be issued to the proper marshal to proceed against the intruders.

By his letter of the 8th of November, 1838, the Secretary of War informed the Commissioner of the General Land-Office that, at the date of his application for a plat of the reservation, he was not sure that the whole island was reserved, or the application would not have been made; and stated that, at that date, it was "deemed advisable not to dispose" of the reservation, and that it would still be held under control of the War Department; and that, when the Department should no longer desire to continue its control, the island would be surrendered to the jurisdiction of the General Land-Office, to be disposed of according to law, as, under the construction put upon the act of March 3, 1819, the reservation could not be sold by the War Department.

On the 31st of August, 1844, George Davenport entered the S. E. ¼ of sec. 25, tp. 18 N., R. 2 W., being a portion of Rock Island, per cash certificate No. 17784. This entry was allowed by special act of Congress, April 2, 1844. (Statutes at Large, vol. 6, page 908.) A patent issued on this entry on the 1st of September, 1845.

On the 22d of December, 1847, the Senate, by resolution, called on the Secretary of War for information if Fort Armstrong, on Rock Island, was at that time occupied as a military post; and also requesting him to communicate his "opinion if the interests of the Government require that said site should be reserved from sale, for military purposes."

In answer to this resolution, the Adjutant-General, on the 24th of December, 1847, informed the Secretary of War that Fort Armstrong was evacuated on the 4th of May, in pursuance of General Order No. 9, dated January 25, 1836, and had not since been garrisoned; that Rock Island was not believed to be of any value for military purposes, and was considered as finally abandoned.

By letter to the Secretary of the Treasury, dated the 11th of February, 1848, the Secretary of War relinquished the military reservation of Fort Armstrong, and placed it at the disposal of the Department which has charge of the public lands.

On the 6th of August, 1850, the Adjutant-General informed the Commissioner of the General Land-Office that the military reservation at Rock Island had been ordered to be sold, but that the sale had been postponed "until further orders"

On the 28th of February, 1855, the S. E. frl. ¼ and E. ½ of S. W. frl. ¼ of sec. 29, and the N. E. frl. ¼ of sec. 32, T. 18 N., R. 1 W., were entered by David B. Sears, per cash certificate No. 37897, under special act of Congress, approved 24th of January, 1855. (Statutes at Large, vol. 10, page 843.) On this entry a patent issued on the 1st of November, 1855.

During the year 1857, it appears from the records in this office that several persons filed declaratory statements on portions of the island, under the pre-emption act of the 4th of September, 1841. A list of these claimants is here given, together with the description of land claimed by each, and the date of settlement and filing, as coming in chronological order.

William H. Fairclough filed D. S. No. 1966, on the W. frl. ½ of S. W. ¼ sec. 29, 18, 1, on the 4th of June, 1857, claiming settlement 9th of April, 1857.

Thales Lindsley filed D. S. No. 1968, on the S. E. frl. ¼ and N. E. frl. ¼ sec. 30, 18, 1, on the 4th of June, 1857, claiming settlement 9th of April, 1857.

Christian Raub filed D. S. No. 1970, on the N. frl. ½ sec. 30, 18, 1, and the N. E. frl. ¼ sec. 25, 18, 2, on the 4th of June, 1857, claiming settlement 9th of April, 1857.

Dudley W. Stewart filed D. S. No. 1971, on the S. W. frl. ¼ sec. 30, 18, 1, on the 4th of June, 1857, claiming settlement 9th of April, 1857.

Theron H. Waterman filed D. S. No. 1965, on the N. E. frl. ¼ sec. 31, and the N. W. frl. ¼ sec. 32, 18, 1, on the 4th of June, claiming settlement on the 9th of April, 1857.

Charles T. Church filed D. S. No. 1967, on the frl. N. W. ¼ sec. 31, 18, 1, and fr. of 36, 18, 2, on the 4th of June, 1857, claiming settlement on the 9th of April, 1857.

William Thomas filed D. S. No. 1973, on the S. W. frl. ¼ sec. 25, and fr. of 36, 18, 2, on the 15th of June, 1857, claiming settlement on the 18th of April, 1857.

Leander S. Butterfield filed D. S. No. 1969, on the S. W. frl. ¼ sec. 25, and the fr. of 36, 18, 2, on the 4th of June, 1857, claiming settlement on the 18th of April, 1857.

Charles F. Calkins filed D. S. 1972, on the S. W. frl. ¼ sec. 25, and the fr. of 36, 18, 2, on the 4th of June, 1857, claiming settlement on the 22d of April, 1857.

J. Pierre Millard filed D. S. No. 1979, on the S. W. ¼ of sec. 30, 18, 1, on the 4th of September, 1857, claiming settlement on the 6th of July, 1857.

In the list of declaratory statements appended to the argument of Messrs. Walker, Stanton, and Mason, it is stated that "Leander S. Butterfield relinquished in favor of C. F. Calkins," and "William Thomas relinquished in favor of L. S. Butterfield." This does not appear from the records of this office.

In addition to the claimants named above, M. Blair, esq., on the 10th of November, 1858, called the attention of the Commissioner of the General Land-Office to the pre-emption claims of certain persons represented by him to land on the island, and asked that their claims be recognized.

The names of the parties represented by Mr. Blair do not otherwise appear on the records of this office in connection with the tracts claimed by them.

Still in addition to these, is the claim of Lewis C. Underwood to the N. W. frl. ¼ of sec. 31, 18, 1.

On the 20th of December, 1858, the Secretary of War informed the Commissioner of the General Land-Office that the old log buildings at Fort Armstrong, in a state of dilapidation, were sold in 1836, and that the remainder, together with the island, were then placed in charge of an agent, and had so continued.

On the 28th of December, 1858, the Commissioner of the General Land-Office, in reply to a request of the Secretary of the Interior, of the 1st of June, 1858, that he would "report whether the land referred to (Rock Island) is subject to pre-emption or to sale under the direction of this (Interior) Department, and if any valid individual claims to any portion of the reservation existed at the date of its withdrawal from sale for military purposes," reported that it did not appear "that there was any valid individual claim to any portion of the island at the date of its reservation in 1825;" and that, in his opinion, the land at the date of its relinquishment as a military reservation "fell back into the mass of the public domain," and became liable to sale under the pre-emption and other laws regulating the disposal of the lands of the United States.

He also states that the claim of Lewis C. Underwood to that portion of the N. W. frl. ¼ of sec. 31, 18, 1, lying within the limits of the island, had been rejected "for the reason that at the date of his settlement it was reserved, and so continued at the date of his application."

Mr. Underwood now presses his claim to that portion of the island, but without presenting facts bringing himself within the provisions of the pre-emption laws.

On the 24th of January, 1859, the Secretary of the Interior, in answer to a resolution of the House of Representatives passed January 8, 1858, reported it as his opinion that the military reservation of Rock Island had never been transferred by the War Department to the Interior Department, and concurred in the opinion expressed by his predecessor, in a letter to the president of the Mississippi and Missouri Railroad Company, dated the 31st of January, 1855, that the disposition of "the public land on Rock Island is entirely within the control of the War Department."

Again, on the 26th of January, 1859, the Secretary of the Interior returned to the

Commissioner of the General Land-Office the papers in the case of Lewis C. Underwood, concurring in the Commissioner's opinion of the 28th of December, 1858, rejecting the claim of Underwood to that portion of the island claimed by him.

The Secretary further says: "By the reservation for military purposes in 1825 the whole island was withdrawn from the jurisdiction of the Land Department, and has so continued since; and that there has never been a time when any of the land on said island was subject to sale by pre-emption or otherwise by the officers of this Department." * * * * * * * "You will instruct the local land-officers immediately not to receive any proof of pre-emption, or any application to purchase said land, nor even to receive or file any declaratory statements for any portion thereof."

On the 29th of January, 1859, the Commissioner of the General Land-Office issued instructions to the register and receiver of the land-office at Springfield, Illinois, as directed by the Secretary of the Interior in the above letter.

Since that date no action affecting in any way the status of the land in question appears to have been taken.

All of which, together with the argument and brief of Messrs. R. J. Walker, Fred. P. Stanton, and Charles Mason, dated the 21st of July, 1862, in support of the rights of certain persons to pre-emption on these lands, and the letter of the honorable Attorney-General, dated the 9th of September, 1862, are most respectfully submitted for your consideration.

Very respectfully, your obedient servant,

J. M. EDMUNDS, *Commissioner.*

Hon. CALEB B. SMITH,
Secretary of the Interior.

The following letters and reports show some of the acts of the General Government upon which the belief that an armory and arsenal would eventually be established at Rock Island were probably founded.

About the year 1835, by direction of Congress, two examinations of various sites for a western armory were made; one by Commissioners McRae, Talcott, and Lee, and the other by Maj. J. S. Smith, United States Engineers. My attention has been called to these examinations too late to permit procuring copies of the reports made on them, or of a report by the Military Committee of the House, on the same subject, made during the first session of the Twenty-fourth Congress.

In September, 1840, the Chief of Ordnance, Colonel Talcott, directed the commanding officer of the Saint Louis arsenal to examine Rock Island, with a view to its use for ordnance purposes, and report. Some extracts taken from this report are as follows:

EXTRACTS FROM REPORT ON ROCK ISLAND BY CAPT. WILLIAM H. BELL, ORDNANCE DEPARTMENT, UNITED STATES ARMY.

Soon after returning, about the 16th of October, 1840, from Cincinnati, I proceeded up the river to Rock Island, agreeably to your orders of the 17th September, and, having surveyed the grounds and buildings of the island, have the honor to report that the whole island, containing 850 acres, belongs to the United States, having been specially reserved from sale for public purposes.

It lies at all times high and dry in the Mississippi, on the side of the Illinois shore, from which it is separated by about 600 or 700 feet; its greatest length lying east and west, being about $2\frac{60}{100}$ miles, and its greatest breadth lying north and south, being 1,463 yards; its perimeter or circumference being $6\frac{1}{4}$ miles.

There are but two occupants on the island; one at the upper or east end, who has no claim upon the grounds; the other on the north side, near the water, at the point marked "Davenport," on an accompanying sketch, which is the name of a very respectable gentleman who has lived there for many years, and who has gone to considerable expense in ornamenting the fractional quarter-section which he claims, and in the erection of buildings thereon.

His claim, however, as I understand, can only be granted by an act of Congress, before which body it has been for several years past, without decision.

It is to this gentleman, as I am informed at the island, that all the old buildings of the United States on the west or lower end of the island, appertaining to the square of old Fort Armstrong, were sold in 1836, by order of the Quartermaster's Department, so that there is at this time but one building on the island belonging to the United States. It is marked "N" on the sketch, being one story, 36 by 28, with a small kitchen

and cellar attached; four rooms below and two above; the wood-work sound, but everything else in ruins. It will require $400 to put it in good repair for an officer.

Soon after the sale of the old buildings of Fort Armstrong, all that were of use were pulled down and carried to the neighboring town of Davenport.

I have examined those that remain, but their ruined state is so great as to make it out of the question to recommend them for repair for the reception of valuable stores, especially as they have first to be purchased at the price of $500. They consist of seven connected log huts, about 20 feet square, rotten and in ruins, and one old frame building, 29 by 18, nearly gone. The sound logs of the huts and of the block-houses might be of use in erecting shanties for workmen, in case such should at any early period be required on the island.

There is among the buildings a small masonry magazine, 10 by 12, five feet to the spring of the arch, without roof, doors, flooring, or ceiling, and thoroughly soaked with water, which was dropping from the arch when I examined it. This building might be put in order for temporary purposes for about $150 or $200; but it would be too small for the purpose intended.

I am of opinion that the following buildings and repairs would be required to accomplish the object intended, viz, to contain 5,000 muskets, 5,000 sets of accouterments, 6 sets of artillery-harness and equipments, and 6 pieces of field-cannon.

The report then goes on to state and describe in detail the buildings that should be erected.

Should it be required to deposit ordnance-stores in the spring, with a view to the defense of Iowa, suitable buildings might be hired in the neighboring towns of Stevenson* and Davenport, until a permanent provision for their reception could be made on the island.

These towns are within half a mile of the site of Fort Armstrong, the former in Illinois and the latter in Iowa. They are highly flourishing, and contain about 1,000 inhabitants, with a thickly-populated country around them, good landing for boats, and a steam ferry between them. The landing on the island is also excellent for boats in two or three places.

The productiveness, health, and beauty of the country surpasses anything I have seen.

I was informed, while surveying the island, that its west or lower end, being at the foot of the upper rapids of the Mississippi, there was consequently a fall of the river, more or less on both sides of the island, from the upper to the lower end, through a distance of about 2¼ miles, and that on the south or Illinois side it had been partially measured by persons owning a small tract nearly opposite the head of the island. They had found as far as measured about four feet fall, and had, in consequence, obtained a charter from Illinois for constructing a mill, one end of the dam of which to rest on the island near about *c d*. This company, however, for want of means, have not proceeded.

Perceiving that an adequate fall attached to the south side of the island would make it tenfold more valuable to the United States, I determined to measure the full extent of the fall with great exactness, that I might be able to communicate definite information to the Department concerning it.

The letter then describes very minutely some measurements of the fall in the river that were made.

At 1½ miles from the mouth of Rock River, which empties into the Mississippi 3 miles below the island, there will also be a water-power, of about 300 run of stones, arising from a dam to enable boats to pass the lower rapids of that river, which dam is in progress by the State.

The water-power will be owned by the State, and will be on the right bank of Rock River, at 3 miles from Stevenson, and at or near the site of what is called † Rock Island City, a town laid out, but not built up. Though this is unquestionably a valuable power, I think that of the island preferable.

I thought it advisable to communicate these facts, that the Government may be fully aware of the value of this island and its vicinity as the greatest and most practicable and desirable water-power in the valley of the Mississippi.

* Stevenson was, in 1840, the name of the town which is now the city of Rock Island.

† This was a town laid out (I believe about 1836) on the west side of the Milan road, and about one mile north of the present town of Milan. Milan is a thriving village on the south side of Rock River, and the water-power at that place is partially utilized, and furnishes power to several mills and factories. It is stated that Daniel Webster owned several lots, and was interested in the projected town—Rock Island City.

In September, 1841, Congress passed an act for a thorough examination of the whole western country "for the purpose of selecting a suitable site on the western waters for the establishment of a national armory."

The board selected by the Secretary of War for the performance of this duty consisted of Brig. Gen. W. K. Armistead, Surg. Gen. Thomas Lawson, and Lieut. Col. S. H. Long.

The examinations made by the members of this board, during the year and a half it was in session, was very thorough. Their report, covering over 400 pages, is printed in Executive Document No. 133 of the Twenty-seventh Congress.

Their report upon Rock Island was as follows:

SITE ON ROCK ISLAND.

This beautiful and interesting island derives its name from the circumstances of its resting upon a bed of rocks, consisting of limestone in horizontal strata well adapted to the purposes of building. It stands in the Mississippi, at the foot of Rock Island rapids. Its length is about two and seven-eighths miles, and its greatest breadth four-fifths of a mile. It contains about 800 acres of excellent land, still the property of the United States. The surface of the island is generally waving, and is pervaded by a broad valley passing centrally and longitudinally two-thirds the length of the island. With the exception of a few acres cleared at the head of the island, (the site formerly occupied by Fort Armstrong, now used, in part, by the United States as a depot of arms for the western country, and a large garden, with other improvements, occupied by George Davenport, esq.,) the island is covered with a dense timber-growth.

The island is bounded, for the most part, by precipitous cliffs or abrupt and rocky hill-slopes, its surface rising ten or twenty feet above the reach of the highest freshets.

The width of the channel on the south side of the island varies from 150 to 300 yards; while that on the north side, which is the main channel of the river, has a width varying from 420 to 700 yards.

A dam 600 feet long has been erected across the south channel 300 yards below the head of the island, which affords a low-water head and fall of about four and a half feet, the surface of the water of the dam being nearly seven feet higher than the low-water surface at the foot of the rapids. In connection with this dam a saw-mill has recently been constructed on the south side of the river, in which a very efficient and forcible water-power has been produced and rendered operative, on the principle of the percussion-wheel.

With the existing arrangements at this mill-site, however, any machinery must unavoidably be liable to interruptions by back-water, and rendered completely inoperative whenever the range at the foot of the rapids exceeds seven feet above low water.

It is, moreover, equally obvious that the head and fall of water at this place are not susceptible of any enlargement or other modification of a character to prevent interruptions during stages of water more elevated than that above designated, without a resort to other means than those immediately connected with the south channel.

It has been deemed important, if not essential, that the power proper for the armory, whether of water or steam, should be constant, and, if possible, entirely exempt from interruptions.

Such a power may be obtained at the site now under consideration in the following manner:

It has already been observed that the entire head and fall at the island, or the aggregate descent from the surface-water of the dam to the low-water surface at the foot of the rapids, is seven feet, nearly. To this fall it is proposed to add the descent from the head of Campbell's Island to the head of Rock Island, which is six and a half feet more; making the aggregate fall, from the head of Campbell's Island to the foot of Rock Island, thirteen and a half feet.

The method of uniting these two falls, and bringing them into conjoint operation on Rock Island, consists in the erection of a river wall or dam, extending upward from the head of Rock Island, parallel, or nearly so, to the Illinois shore, till it reaches the foot of Campbell's Island—the distance between the two islands, and consequently the extent of the wall, being three miles and three-quarters.

The height of the wall should be such that its summit may be elevated at least two feet higher than the low-water surface at the head of Campbell's Island, in order to secure a head and fall at least three feet greater than the extreme range at the foot of the rapids, which is supposed to be twelve feet above extreme low water at that point.

In addition to the wall, a dam will also be required across the south channel at Rock Island, the appropriate locality for which is at a point, about midway of the island, where the rapids in that channel have their lowermost termination. The length of the dam will be about 300 feet, and its height above extreme low water fifteen or sixteen feet.

The water-power thus created may be conveyed from a point a little above the dam through a deep-cut race leading across a ridge on the southerly side of the island, twenty-five to thirty feet high and 150 yards wide, and terminating in another race or canal formed centrally and lengthwise of the island; from which last the power may be conducted and displayed through races leading to either or both sides of the island near its lower extremity.

The following items taken from the minutes of the survey executed by Mr. Ogilvie for the use of the board will explain more clearly the extent and declivity of that part of Rock Island Rapids of which we have been treating:

Distance from the head of Campbell's Island to the foot of Rock Island...	8¼ miles.
Aggregate fall in the above distance	12.96 feet.
Extreme range from lowest to highest water at head of Campbell's Island..	5 feet.
Extreme range from lowest to highest water at the foot of Rock Island...	12 feet.
Length of Campbell's Island	1½ miles.
Fall from head to foot of Campbell's Island	2½ feet.
Distance from foot of Campbell's Island to head of Rock Island	3¾ miles.
Fall in this distance	3½ feet.
Length of Rock Island	2¾ miles.
Fall from head to foot of Rock Island	6.96 feet.

The cost of providing for a water-power in the manner above contemplated, and of remunerating the proprietors of the present dam and mill for the damage that will be done to their improvements, may be stated as follows:

River-wall, 3¾ miles, or 20,000 feet long, 8 to 15 feet high, at $10 per foot...	$200,000
Dam, 300 feet long and 16 feet high, at $20 per foot	6,000
Canals, races, forebays, &c., on Rock Island, 3,000 linear yards, at $12 per yard	36,000
Damages to proprietors of dam and mill, as valued by themselves, covering the purchase of their entire site and its privileges	40,000
Amounting to	282,000

Building-materials of all kinds are to be had in abundance upon Rock Island and in its vicinity. Sawed lumber, consisting of white and black oak, black walnut, yellow poplar, ash, and cherry-tree, is prepared in this neighborhood, and afforded at prices varying from twelve to twenty dollars per thousand, board-measure. Pine lumber is procured from the Wisconsin, Black, and Saint Croix Rivers, and can be afforded at about the same rates.

The woodlands of this part of the country occupy about one-sixth of the entire surface, the remaining five-sixths being prairie. The growth of the woodlands is generally scattering, and consists of white, red, and bur oak, black and white walnut, yellow poplar, wild-cherry, sugar-tree, maple, linden, red and white hickory, yellow birch, dogwood, &c.

The soil is generally rich, and in places where it has been cultivated gives evidence of exceeding fruitfulness. Corn, wheat, rye, oats, flax, hemp, tobacco, apples, pears, and other fruits, potatoes, turnips, radishes, and culinary roots and vegetables are produced in great abundance and perfection.

Bituminous or stone coal is found in abundance in this neighborhood. It generally occurs in the river-hills, at different elevations from five to thirty or forty feet above their bases, and in veins from two to four and a half or five feet thick.

Lead is obtained in abundance from the mines of the Upper Mississippi and Wisconsin Rivers, and iron-ore is said to abound in many parts of the country. Articles of subsistence of all kinds, for man and beast, are abundant; and these are remarkably cheap, especially those produced in the neighborhood.

The site is remarkably healthy, as evinced by the reports, now on file in the office of the United States Surgeon-General, in relation to the health of the troops stationed at the various military posts of the United States, and covering a period of more than twenty years, during which the number upon the sick-list at Fort Armstrong was proportionally less than at any other post in the western country.

The navigation of the Upper Mississippi is liable to annual obstructions by ice during a period of about three months, beginning on the first of December and ending on the first of March. On the breaking up of the ice, especially when it is thick and strong, jams of this solid material are often formed at narrow passes of the river, and especially at the heads of islands, by which the river is divided into two or more narrow channels. On such occasions, those parts of the river situated above the jams

are liable to sudden and excessive floods, which inundate the bottoms to a great depth and extent.

In a dry season the river is liable to obstructions from sand-bars, so that a boat drawing more than two or two and a half feet cannot pass the shoalest places, even in the deepest channel, without impinging against the bars. Extreme low water seldom continues more than a few weeks, and sometimes only a few days at a time.

At a medium stage of water, the river is navigable for boats of the largest classes, from the mouth of the Missouri to the foot of the Des Moines Rapids, from the head of these rapids to Rock Island, and from the head of Rock Island Rapids to Fort Snelling, at the mouth of Saint Peter's River.

A committee of the citizens of Rock Island County addressed the following to the President:

The undersigned, a committee acting in behalf of the citizens of Rock Island County, Illinois, would respectfully lay before you the following facts and considerations in favor of your selecting Rock Island to be the site of the western armory.

Rock Island is in the Mississippi River, about three hundred miles above Saint Louis, and one hundred miles below Galena. It was the site of Fort Armstrong, and has recently been selected by the War Department as a place of deposit for the public arms.

The title to the island (which is about three miles long and from one to three-fourths of a mile wide) is in the United States. The selection of Rock Island, then, for a place for the western armory would obviate the necessity of any expenditure for the purchase of a site, and would save the expense of buildings for an arsenal.

The facilities for supplying the West with arms from Rock Island are obvious. By the Mississippi and its tributaries it could supply the ten States and two Territories bordering upon them. Rock River and the Milwaukee and Rock River Canal, the improvements of which will be completed before an armory can be put in operation, will furnish a water-communication with Lake Michigan, through which arms can be sent to the States and Territories bordering on the northern lakes. We may add that we have often heard distinguished gentlemen connected with the War Department express the opinion that there is no point in the Western States from which arms can be sent to the different military stations with less expense and greater dispatch than from Rock Island.

But its advantages for the manufacture of arms furnish the strongest reasons why Rock Island should be selected as a site for the western armory. It is in the vicinity of one of the richest mineral regions in the world. For satisfactory information on this point, we would refer you to the report, made to Congress in 1839, by Dr. Owen of his geological and mineralogical survey of the country bordering on the Mississippi above the mouth of Rock River. We would add that since his survey many valuable beds of ore have been discovered.

The country abounds in rich beds of ore of iron, copper, zinc, and lead; and, in the immediate neighborhood of Rock Island, there is the greatest abundance of bituminous coal of the best quality.

In its vast water-power Rock Island possesses advantages greater than can be urged in favor of any other place. A dam has been recently constructed from Rock Island to the Illinois shore, by which a water-power is made that can be used for nearly a mile upon Rock Island, and for several miles upon the opposite shore. It has been carefully surveyed by distinguished engineers in the service of the United States and of Illinois, and pronounced by them all to be the best water-power in the Western States.

From its having this water-power Rock Island urges a stronger claim than can be presented by any place where steam must be used to propel machinery. And in the magnitude of this power, viewed in connection with the slight expense necessary for its application, it has hydraulic advantages greater than are possessed by any other place.

We would also urge, as an important consideration in favor of Rock Island, that its location is favorable for health. Eminent physicians, acquainted with its locality, unhesitatingly pronounce it one of the most healthy places in the West. A single fact can be stated of vast weight on this point: During the time that Rock Island was occupied by the garrison in Fort Armstrong, an examination was made of the health-returns sent to the War Department, for seven successive years, from the different military stations. It was found that Fort Armstrong, upon Rock Island, was during that period the most healthy military station in the United States.

We need not add that a favorable location for health is an important consideration where a large number are to be employed on the public works; and especially is this important in the West, where most of the public works are annually suspended during what are called the sickly seasons.

From the fertility of the surrounding country, and the easy communication with other parts of the United States, it is evident that supplies for an armory may be obtained at as reasonable prices at Rock Island as at any other place.

We add but one consideration further: In selecting sites for its public works, it has ever been the policy of the Government to give the preference (other things being equal) to places distinguished for their delightful scenery and beautiful location for public buildings. It was from these considerations that the principal buildings of the armory at Springfield, Mass., were located at an inconvenient distance from the place where it has its water-power.

Rock Island, elevating its rocky front high above the waters of the Mississippi, and looking out upon the scenery of a country described by a distinguished traveler as the most beautiful the eye ever rested upon, possesses peculiar advantages for the erection of public works, which exhibit a happy combination of utility with imposing beauty.

We would refer you to the officers of the Army who are acquainted with the advantages of the different places in the West which are now presenting their claims for the location of the armory. We are authorized to assure you that the officers stationed upon the northwestern frontier express their preference for Rock Island.

Especially would we ask your attention to the minute report made to the War Department last year of the advantages of Rock Island, by Captain Bell, of the Ordnance Department, who is now stationed at Jefferson Barracks, and we are happy in being permitted to refer you to Captain Bell as a gentleman qualified by his attainments and recent minute surveys to furnish you with accurate information respecting the peculiar advantages of Rock Island as a site for the western armory.

In conclusion we would remark, that while many places better known than Rock Island for their business and enterprise, are having their advantages for an armory presented to you by distinguished and influential individuals, we confidently rely upon the assurance given us by the most important acts of your life, that, while you give due consideration to individual opinions, you will be governed by a regard to the public interests in selecting a site for the western armory; and we therefore present the claims of Rock Island to your attention as a site possessing unequaled advantages for the manufacture of public arms, and the greatest facilities for their importation to the different military stations in the Western States and Territories.

JOHN BUFORD,
JOSEPH KNOX,
JOSEPH B. WELLS,
JOHN MORSE,
GEORGE MIXTER,

Committee in Behalf of the Citizens of Rock Island County, Illinois.

His Excellency JOHN TYLER,
President of the United States.

The report of the commission, of which General Armistead was president, finally recommended Fort Massac, on the Ohio River,* as the best site for the armory, but no effective action in the matter was taken by Congress.

From the date of the above report till Congress finally decided upon the establishment of an arsenal at Rock Island, records and correspondence show that the subject was not forgotten. Debates in Congress when bills were introduced for the sale of the island, and letters and reports from the War Department (some of which will be copied further on) when efforts were made by various parties to get possession of the island, recommended in the strongest terms that the island should under no circumstances be relinquished by the War Department, because it would eventually be required by the Government as a site for a great armory and arsenal for the Mississippi Valley.

The following extracts are taken from many letters from eminent men on this subject:

General Jesup, Quartermaster-General, writing to the Secretary of War, 1852, says:

The site of Fort Armstrong, Rock Island, is one of the most valuable in our western country for an armory. The whole water-power of the Mississippi River is available. If a western armory is to be established, I would advise that it be placed there. The island is under the control of an agent who resides on it, and who is under the orders of, and reports to, the quartermaster at Saint Louis. The agent should protect the property from depredation. I would not advise that any part of it be rented or leased.

* Surgeon-General Lawson did not agree with the other members of the commission, and did not sign their report. He made a separate report of great length, in which he recommended a point of land on the Mississippi, between Carondelet and the mouth of Des Peres River, as the best site for the armory.

Hon. A. C. Dodge, chairman of Senate Committee on Public Lands, writing to the Secretary of War, in 1854, says:

Rock Island, as you are well aware, has long been regarded by a large portion of the people in the Mississippi Valley as an advantageous site for an arsenal of construction.

Hon. Jefferson Davis, while Secretary of War, wrote, in 1854, to the United States Senate Committee on Public Lands as follows:

I have the honor to acknowledge the receipt of your letter of the 10th instant, asking the views of this Department as to the expediency of selling the military reservation at Fort Armstrong, on Rock Island, Illinois, as contemplated by Senate bill No. 195.

The water-power available at that place and the communication by water and by railroads, projected or in the course of construction, concur with other circumstances in rendering Rock Island one of the most advantageous sites in the whole western country for an armory or an arsenal of construction for the manufacture of wagons, clothing, or other military supplies. There may be more land on Rock Island than will be needed for the proposed establishment, but, if this be so, the Department cannot decide at present what part of it will be required. Any act that may pass to authorize the sale of it, should, I think, leave to the Department full power to retain whatever of the reservation may be found useful and proper for the contemplated works, for which it is hoped that Congress will at some future day make the necessary appropriation.

The Mississippi River is one of the great highways of the United States; its use is essential to the public service in peace and in war, and appropriations from the Treasury have been made, and are now in the course of expenditure, for the removal of natural obstacles from its channel; therefore, though not directly connected with the question of sale, it may not be improper to invite your attention to the effect which would follow the construction of a bridge across the river at Rock Island, as implied in the grant of the right of way.

It was generally known in the vicinity of Rock Island that, on the 11th of February, 1848, the Secretary of War had written to the Secretary of the Interior formally relinquishing the reservation of Rock Island. It was supposed, or at least hoped, that this act of the War Secretary threw the island reservation into the mass of the public lands, and that they could be acquired by pre-emption. Subsequent legal opinions (except that of Judge McLean, United States *vs.* Railroad Bridge Company, 6th volume McLean, page 517) and the continued acts of the Government in refusing to consider the island as a part of the public lands, show that the action of the Secretary of War did not, and that he had not the power to, return the island to the mass of public lands. His compliance with certain requirements of the act of June 14, 1809, made the island a reservation by the terms of that act, and it could not be returned to the mass of public lands except by act of Congress.

It was on account of this supposed relinquishment of the island, however, that the mill-owners and others at the east end of the island supposed that they could get that part of the island by pre-emption. It will also appear, further on, that other intruders were appearing on the island, and by 1854 the Chicago and Rock Island Railroad Company had taken possession of land on the island, and all the lands on the island were soon settled by squatters with a view to pre-emption. In the Thirty-seventh Congress, prior to the passage of the act approved July 11, 1862, to establish the Rock Island arsenal, (United States Statutes, volume 12, page 537,) a bill was introduced, and passed to its third reading, to establish at Rock Island an armory and arsenal of the great magnitude that subsequent acts* have provided for; but the desire of other localities in the West to obtain the arsenal finally led to a substitute for this. This substitute was the act of July 11, 1862.

General C. P. Buckingham, in a report to the Secretary of War, dated October 24, 1862, writes as follows:

Leaving Indianapolis on Saturday night, I arrived at Rock Island on Monday morning, and spent the day in examining the locality.

* See volume 13 United States Statutes at Large, page 50, and many subsequent acts.

The island is, without doubt, the best place for an arsenal. It is high and healthy, well supplied with water from the Mississippi River, and the Chicago and Rock Island Railroad is easily accessible. It contains about nine hundred acres of land, of which about two hundred have been granted by Congress to individuals, leaving about seven hundred in possession of the Government.

The only question connected with the location of an arsenal at this point is, I conceive, whether it shall be at the upper or lower end of the island, which is about two and a half miles long. At the upper end is a water-power, that can be had without cost to the Government, except for water-wheels and flume. The small town of Moline is accessible by a good wagon-bridge, and is principally settled by mechanics connected with mills and factories in operation by water-power on the Illinois shore. Most of this end of the island is also covered with forest, and capable of handsome improvement. The lower or west end is probably higher ground than the upper end, and contains about seventy acres, including old Fort Armstrong, west of the railroad, where it crosses the island. It has a good steamboat landing at all seasons when boats can run, and is easily accessible from the railroad, and from the cities of Rock Island and Davenport by foot-walks across the railroad-bridges. The ground is sufficiently rolling to be well drained. Water must in either case be procured from the Mississippi River.

As steam-power will probably be the most convenient and reliable, I think the advantages of the lower end of the island for the purposes of an arsenal are superior to those of the upper end.

Afterward, while the subject of enlarging the arsenal and adding an armory to it, in accordance with the original intention, was under consideration, among many other papers on the subject, the Chief of Ordnance, General Ramsay, in 1864, sent an important letter to the Secretary of War, which is still pertinent to the subject. After proving the importance and necessity of having another large armory in addition to the one at Springfield, the letter says:

As regards the most eligible position for such an establishment, both military and political considerations point to some location in the West, as near as possible to the center of population, of railway and water communication.

The valley of the Mississippi, if not at the present moment, must of necessity, at no very distant period, be the most thickly settled portion of the country west of the Alleghanies; while, at various points along the valley, railroads and rivers afford direct means of communication with all parts of the Union. After a careful study of this question of location, there is no position which, to my mind, affords so many advantages, and, at the same time, presents so few objections, as Rock Island, in the Mississippi River.

In a military point of view it is perfectly secure from an enemy, advancing either by the lakes or the river. From it, supplies can be transported in any direction and at any season of the year. It is in the midst of a country teeming with coal and wood, and especially adapted to agriculture—an important element in cheapening labor. The site is elevated far above river-floods, the climate and situation are healthy, and while the island is sufficiently isolated to secure it from sudden attacks, it is near enough to the cities of Rock Island and Davenport to afford ample accommodations for all the necessary employés. The natural advantages of this site are set forth at length at page 32 of House Ex. Doc. 133, Twenty-seventh Congress, third session. Beside the many natural advantages which Rock Island possesses for an establishment of this description, there is an additional incentive to carrying out the views herein expressed, since the law makes it imperative that an arsenal for the construction of arms shall be built there.

The first section of "An act in addition to 'An act for the establishment of certain arsenals,'" approved April 19, 1864, is in these words: "That the Secretary of War be, and he is hereby, authorized and empowered to take and hold full and complete and permanent possession, on behalf of the United States, of all the lands and shores of the island of Rock Island, in the State of Illinois; the same, when so possessed, to be held and kept as a military reservation by the War Department, upon which shall be built and maintained an arsenal for the construction, deposit, and repair of arms and munitions of war, and such other military establishments as have been or may be authorized by law to be placed thereon in connection with such an arsenal."

The clause, "upon which shall be built and maintained an arsenal for the construction, deposit, and repair of arms," &c., is explicit, and no further authority is wanted to carry out the plans indicated in this paper. Moved by a sense of the great importance of the military and economical considerations herein presented, I deem it my duty to call the attention of the War Department to this law, and to the necessity of prompt and energetic action in these premises.

With the view of seizing the valuable experience gained at the Springfield armory

during the past three years in the process of making arms—experience more valuable than any heretofore procured by any country in the world—Major Dyer, during the past winter, was engaged in preparing plans of an armory, based on the present arrangement of his shops, which should embody all the changes and improvements which the daily events and business of the one at Springfield suggested. These plans have been completed, and are now ready for any use which it may be found necessary to make of them.

In calling you attention, therefore, to the general subject of a manufactory of arms at the West, I have the honor to submit to you three plans, embodying, as they do, the experiences of many years of manufacture and three years of war, and the invaluable acquirements in this art of men who, for years, have made the manufacture of arms a study.

In presenting them I would further recommend that a board of three ordnance officers be assembled at Rock Island, as soon as practicable, to examine the island and determine upon the most advantageous site for the contemplated buildings.

As vigorous measures are now being taken to erect the arsenal at this point, in compliance with the law of July 11, 1862, and in case the considerations herein presented are approved, it will of necessity materially affect the plans now being carried out, I therefore suggest that, pending the settlement of the question, instructions be sent to the commanding officer of Rock Island arsenal to suspend operations on the arsenal building for the present.

If this matter is now taken up and pressed with vigor by this Department, there is no reason why, within a month, the site cannot be selected and operations commenced.

The business of this office is so systematized and arranged that any operations undertaken there will in nowise interfere with promptly supplying our forces in the field with every munition they may require.

ATTEMPTS OF VARIOUS PARTIES TO OBTAIN TITLE OR CLAIM TO LANDS ON ROCK ISLAND, BY SETTLEMENT, PRE-EMPTION, LONG LEASES, PURCHASE, CESSION, ETC.

In 1825, at the request of the Secretary of War, the whole of Rock Island was reserved from the public lands of the United States for military purposes; and orders to that effect were sent by the Commissioner of the General Land-Office, in Washington, to the register in Springfield, Ill.

Notwithstanding this, a new land-office having been established at Galena, Ill., some time in 1832, Rock Island was surveyed by a Mr. Bennett, employed by the United States surveyor-general, and was divided into sections and quarter-sections. This survey is shown on the map on Plate V.

Fort Armstrong was at that time commanded by Lieut. Col. William Davenport, First United States Infantry, who at once informed the War Department that the survey had been made, and that he feared it would bring the island into the body of United States public lands and subject it to pre-emption. In the following August (1833) Colonel Davenport wrote again, on the same subject, to the Adjutant-General of the Army, urging that some action be taken in the matter, and stating that unless something was done to prevent it he believed the site of the fort might be acquired by settlers under the pre-emption laws. After some correspondence between the War and Interior Departments, the whole island was again, in 1835, reserved to the War Department for military purposes, and on September 15, 1835, the following order was sent to the register at Galena:

The Department of War has apprised this office that Rock Island, in the Mississippi River, (supposed to contain from 1,500 to 1,600 acres,) and which has been in the occupancy of the public since 1816, and a part of it cultivated then and every year since by the troops at Fort Armstrong, is essentially necessary to be reserved for the use of that garrison. You are therefore directed to reserve the same from any public sale; and if any individual, who may have occupied by sufferance any portion thereof, should attempt to acquire a pre-emption claim on said island in virtue of the act of 19th June, 1834, such claim cannot be recognized.

It does not appear that this reservation was necessary so far as the site of Fort Armstrong was concerned, and it was probably only intended to cause the whole island to be included in the reservation.

The act of June 14, 1809, (2d volume United States Statutes at Large, page 547,) coupled with the action of the Secretary of War in occupying the island for military purposes and building a fort thereon, effectually reserved the site of the fort, if not the whole island, from the public lands without any other action.

It may be stated here, though somewhat out of place, that Colonel Davenport, in 1833, informed the War Department that Mr. George Davenport, who then had a trading-post on the island, with a dwelling-house, store, and other improvements, had been settled on the island since it was first occupied, in 1816; that he claimed the land where he was living under the pre-emption laws, and he (Colonel Davenport) recommended that the claim be admitted, with the reservation that it should not be enforced so long as the island was required for military purposes.

After the island was reserved for military purposes, and the above orders issued from the General Land-Office, Mr. Davenport's claim could not be admitted, but some years afterward, and after much correspondence, at the request of Senator Douglas, Judge Knox, Judge Drury, and other influential men in Illinois, the following special act of Congress was passed, and Mr. Davenport acquired thereby his estate on the island, (see map on Plate No. V,) which was held by him and his family till repurchased by the Ordnance Department, for $40,740, in 1867:*

(United States Statutes at Large, volume 6, page 908; private acts of the Twenty-eighth Congress, chapter 9.)

AN ACT for the relief of George Davenport, of Rock Island, in the State of Illinois.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That George Davenport be, and he is hereby, authorized to enter the fractional quarter-section of land upon which he resides, on Rock Island, in the State of Illinois, it being the southeast fractional quarter of section twenty-five, in township numbered eighteen north, range numbered two west of the fourth principal meridian, upon his paying to the receiver of public moneys of the United States land-office at Dixon the minimum price of one dollar and twenty-five cents per acre for the same, upon which a final certificate and patent shall issue, as in other cases.

Approved April 2d, 1844.

Immediately after the troops were withdrawn from the island, in 1836, notwithstanding the action of the War and Interior Departments stated above, "squatters" appeared on the island and settled on the lands with the intention of pre-empting them, and, as it appears from many reports and letters, did great damage by cutting timber. The following statement is related, from many others on the same subject. It shows pretty clearly the extent and character of the depredations on the island at that time, and the great interest that Mr. Davenport took at all times in the preservation of the island:

George Davenport, of Rock Island, having exhibited to the undersigned a letter from the Secretary of War to him, authorizing him, the said Davenport, to take the necessary legal course to protect the military reservation on Rock Island from depredation and settlement, requested the undersigned to examine the settlements made and in the act of making, and the destruction of the young growth and timber, and various depredations making on the said military reservation. The island, though once apparently well timbered, has been nearly all cleared of the original growth by the public during the long continuance of the United States garrison of Fort Arm-

* On the 4th of July, 1845, Col. George Davenport was brutally murdered in his own house, his family being absent at the time at a picnic. The murderers escaped unrecognized, but were afterward detected, and three of them, Aaron Long, John Long, and Granville Young, were executed on the 19th of the succeeding October.

strong on the island, and persons under their permission and those attached to the Indian agency. During some years of the occupancy of the fort by the United States troops most of the timber and fuel, we are informed, was procured from the main shores adjacent, as the young forest springing up on the island had not attained to a sufficient size to be profitably used as timber or for fuel. The value of the lands on the island must from its situation depend on the preservation of this young forest of timber growing up and rapidly attaining a size of usefulness. This consideration renders the interference of the United States absolutely necessary to prevent so fine a portion of their land from becoming rendered comparatively worthless.

The undersigned passed round and through the wooded part of the island. The first house we observed above the residence of said Davenport on Rock Island is a new log cabin, said to be owned by Charles Baxter; here is a small chopping and some much-used new roads going into the island radiating from the cabin. We did not go into the house, and saw only one boy at the place, with an ox-wagon, apparently preparing to go off with the wagon to work, as the oxen were hitched to the wagon and the boy mounted on it.

We then proceeded a few hundred yards and discovered a clearing of about four acres partly fenced with new rails. A few scattering trees are left standing in the last clearing, all the undergrowth cut and taken off. In the clearing was Charles Baxter with an ax in his hand, apparently going on with his clearing. This last field we understood was claimed by Absalom Baxter, an elder brother of Charles Baxter. In going down the opposite side of the island on the southeast we discovered a small clearing and a fence running into the island in the direction of the last-mentioned field, and understood this was the same claim of Absalom Baxter, extending across the island from the main river on the north to the arm running round the south side of Rock Island. In the two claims of Absalom and Charles Baxter there is great depredation committed upon the timber and much injury to the value of the land by denuding the island of timber and fuel, which, from its situation, surrounded by large tracts of prairie-lands, are emphatically important. At the head of the island Donnoho Williams was at work on a new framed house, apparently of two rooms, and preparing, as he said, to move on to the island. He had cut but little timber, having only made a small opening in the young growth, and planted some trees and herbs. After this we saw but little depredation and evidence of settlement, excepting the fence and chopping made on the southeast arm of the river, said to be made by A. Baxter, as previously mentioned, as his claim and settlement extended across the whole island. There was a small log cabin and one little chopping of no moment further on.

The greatest violation of the reservation, requiring notice as threatening damage to the value of the land in a subsequent disposition of it by the United States, is the destruction of timber and fuel, young and old, and the taking possession of favored spots of land, presenting to bidders, when a sale may be ordered, a previous occupancy, though this occupancy has commenced under a full knowledge of the reservation of the whole island.

Absalom Baxter, though not residing in person on his claim, is living with a part of his family in one of the old houses in Fort Armstrong, on the lower or western extremity of the island.

The island is about two and a half miles long and about three-quarters of a mile wide, and is within the limits of the military reservation.

JOSEPH M. STREET,
United States Indian Agent for the Sac and Fox Indians, Rock Island.
MILES W. CONWAY.
JAMES COPP.
GEO. L. DAVENPORT.

This statement was sent to Mr. David J. Baker, the United States attorney at Kaskaskia, Ill., and by him was sent to Mr. J. R. Poinsett, Secretary of War. Mr. Baker urged that he be empowered to eject the intruders from the island, and stated authority for such action was conferred on the President of the United States by the act of Congress of 1807. The matter was submitted to the President by Mr. Poinsett, and the following was his indorsement thereon:

The Secretary of War will give the necessary instructions to the marshal, and take such other legal measures as may be requisite, for the removal of the intruders from the military reservation at Rock Island.

MARTIN VAN BUREN.

The sequel does not show that the above order was effectual in procuring the removal of the squatters, and the whole subsequent history of the depredations on the island shows that the civil authority and United States marshals were generally inefficient or powerless in the attempts made to remove offenders.

THE MOLINE WATER-POWER COMPANY'S CLAIM—LANDS OCCUPIED AND SUBSEQUENTLY LEASED AT THE EAST END OF THE ISLAND—D. B. SEARS ACQUIRES TITLE, ETC.

In 1837 the following act was passed by the legislature of the State of Illinois:

AN ACT to authorize John W. Spencer and David B. Sears to build a mill-dam across Rock Island slough.

SECTION 1. *Be it enacted by the people of the State of Illinois, represented in the general assembly*, That John W. Spencer and David B. Sears are hereby authorized to build a mill-dam across the Rock Island slough, in Rock Island County, on or opposite their own lands; and the said John W. Spencer and David B. Sears shall be entitled to all the advantages accruing or growing out of said mill-dam and water privilege.

SEC. 2. Said mill-dam shall be commenced within one year and completed within three years from and after the passage of this act: *Provided, however*, Said mill-dam shall be so constructed as not to interfere with private rights.

SEC. 3. The legislature reserves the right to alter, amend, or repeal this act, whenever, in its opinion, the public good requires the same. This act to be in force from and after its passage.

Approved 11th February, 1837.

In 1839 the time of this charter was extended, and in 1841–'42 Mr. D. B. Sears built the dam authorized (so far as the legislature of Illinois had authority in the matter) in the above act. The question of abutting the dam against the island was not mentioned in the act.*

At various times after the completion of the dam, mills to be driven by the water-power, tenements, and other buildings were erected on the east end of the island adjacent to the dam, (see map on Plate V.) In 1846 another dam was built on the north side of the island to Benham's Island, by D. B. Sears.

Before proceeding further with the account of the occupation of the east end of the island by mill-owners, &c., it is necessary to give an account of an attempted or

PROPOSED SALE OF THE ISLAND IN 1859.

It was generally the opinion among persons in the vicinity of Rock Island who were acquainted with the history of this matter at the time, and there is some correspondence to show that this sale was projected by and nearly accomplished through the influence of a party of speculators in Saint Louis and New York who wanted to get possession of the island. They were aided in their scheme by the fact that the United States had thus far been unsuccessful in any attempt to eject from the island squatters and other intruders; and it was represented that unless the island was sold these intruders would gradually acquire it by pre-emption or otherwise, and the United States would lose this valuable property without receiving therefor a *quid pro quo*. If sold to pre-emptors, the price would be a dollar and a quarter per acre, and the Government would not get more than $1,200 for the whole island, whereas it was represented to be worth $100,000 or more, and probably something like that sum would be realized by the Government in a sale to the highest bidder at public auction. At this time General Zachary Taylor was President, Hon G. W. Crawford was Secretary of War, and Hon. Jefferson Davis was chairman of the Military Committee of the Senate.

* For further history of the Moline Water-Power Company and its claim see Chapter VII on this subject.

After much correspondence on the subject, the following orders were finally issued:

WAR DEPARTMENT,
Washington, D. C., January 7, 1850.

The President directs that the reservation at Rock Island be sold. Brevet Brigadier-General Mason or some other will be detailed to superintend the sale.

G. W. CRAWFORD,
Secretary of War.

WAR DEPARTMENT, ADJUTANT-GENERAL'S OFFICE,
Washington, February 27, 1850.

GENERAL: I inclose herewith * * a letter from Brevet Colonel A. C. Mackay, department quartermaster-general, of December 19th, 1849, concerning military reservation on Rock Island, with indorsements of Secretary of War. With a view of disposing of the public lands at the places above mentioned, you are, by direction of the Secretary of War, charged with the duties of superintending the sale of said reserves, or such parts as can be dispensed with, according to his instructions indorsed on the papers inclosed. You will take all proper measures to sell this public land to the best advantage and with as little delay as circumstances will permit. Due notice should be given by advertisements.

I am, general, very respectfully, your obedient servant,

R. JONES,
Adjutant-General.

Brevet Brigadier-General R. B. MASON,
Colonel First Dragoons, Jefferson Barracks, Mo.

The intended sale was not advertised in newspapers in the vicinity of Rock Island, and was not known there until about two weeks before it was appointed to take place, when an advertisement of it was discovered in a Saint Louis paper—the Missouri Republican.

The citizens of Rock Island and vicinity were opposed to the sale, and desired that the Government should retain the island as a reservation for military purposes. It is probable that the examination of the island at various times by officers of the Government with a view to its occupation and use for arsenal purposes was generally known, and that there was a general expectation or feeling that this consummation, devoutly wished for, would eventually be accomplished.

Action was immediately taken to prevent the sale, if possible. A remonstrance and many letters and dispatches were sent to the Hon. E. D. Baker, in Washington, member of Congress from the Rock Island district.

By reference to the history of the Moline Water-Power Company, in Chapter VI, it will be seen that the affairs of this company at that time were in such a condition that the water-power was practically the property of the company's bondholders in Syracuse, N. Y. It was feared that if the island were sold, the uncertain tenure of the company and of the parties who were building mills, &c., on the island, near the dam, would be destroyed. Mr. P. R. Reed, of Syracuse, N. Y., was one of the parties most interested in the water-power, and he was telegraphed to to go to Washington to stop the sale. Mr. Reed went to Washington at once, and receiving, as he states, little or no assistance from the member from the Rock Island district, (Mr. Baker,*) he applied to the two United States Senators from Illinois, Stephen A. Douglas and James Shields.† Mr. Douglas took an active interest in the matter, and promised that the sale should be prevented. It appears, from subsequent events, that Mr. Douglas took pains at this time to inform himself

* E. D. Baker was a colonel of volunteers in the late war of the rebellion, and was killed at Ball's Bluff, Va., in 1861.

† Senator Shields was a general officer during the Mexican war, and was dangerously wounded, being shot through the lungs at the battle of Cerro Gordo, April 18, 1847.

pretty thoroughly on matters relating to the island. The following letter and some other correspondence shows that Colonel Baker was not remiss in attending to the wishes of his constituents:

WAR DEPARTMENT, *Washington, June* 12, 1850.

SIR: I have had the honor to receive yours of 11th instant, and as requested give the earliest answer. Assured of your verbal statement in respect to all interests concerned in the sale of the public reserve at Rock Island, I have concluded to suspend it for the present, and issued an order to that effect. That order was sent in duplicate by telegraph on the 10th instant, so as to secure the object desired.

I am, very respectfully, your obedient servant,

G. W. CRAWFORD,
Secretary of War.

Hon. E. D. BAKER,
Washington, D. C.

ADJUTANT-GENERAL'S OFFICE, *June* 10, 1850.

Brevet-Brig. General R. B. MASON,
Fort Armstrong, Rock Island, Ill.:

The sale of Fort Armstrong and the reservation will be postponed until further orders.

R. JONES, *A. G.*

The above dispatch was not received by General Mason till late in the day appointed for the sale. He had arrived at Rock Island on the day before, and was taken over to see the island by Judge Wilkinson, Hon. B. Davenport, and other prominent citizens, and the great value of the property to the United States was fairly represented to him. It was pretty evident that the sale would be forcibly interfered with. The feeling was strong that it had been brought about by sharp speculators in Saint Louis and the East. Mr. D. B. Sears and others occupying property on the island had printed posters on the island and in the town warning bidders that if they attended the sale it would be at their peril. Some of the parties on the island were anxious to purchase the lands they occupied, and were prepared to bid on them. It was plain to General Mason, however, that a sale advantageous to the Government could not be made. He telegraphed to Washington and urged that it be postponed. Next morning, having received no reply, he telegraphed again. After waiting until about 2 o'clock in the afternoon he received the above dispatch while on his way to the island to commence the sale.*

One benefit resulted from this attempted sale. It called the attention of so many prominent men to the subject that future attempts of the same kind were less likely to succeed.

We may return now to the occupation of the east end of the island by mill-owners, &c.

The following report to the Quartermaster-General, giving a statement of the various parties who had located in the vicinity of the water-power at the east end of the island prior to 1854, was sent to the Quartermaster-General of the Army by the custodian of the island, Mr. J. B. Danforth, jr., on the 8th of March, 1854:

Agreeably to your orders of the 25th ultimo, I have the honor to report to you the following trespasses and depredations which have been committed upon the island:

In 1841 a dam was built from the island to the Illinois shore by David B. Sears.

* It appears that the attention of President Taylor had not been specially called to the intended sale of Rock Island. About the time fixed for the sale, Hon. Jefferson Davis, having heard of it, wrote a note to General Taylor and expressed his oft-repeated views respecting the preservation of the island for future use by the Government. The President found the Secretary of War had already ordered the sale to be *postponed*, but it is supposed that he prevented its being renewed. Both General Taylor and Mr. Davis were acquainted with the island, having seen service there, the former in the war of 1812, and both during the Black Hawk war.

In 1846 two saw-mills were built upon and below this dam, one by Spencer H. White and the other by Atkinson and Chamberlin.

In 1848 a dwelling-house was erected on the island by S. H. White.

In 1851 a sash and blind manufactory was erected on the island by Charles Atkinson.

In 1852 a large building, two stories high, 40 by 100 feet, and used for various manufacturing purposes, was erected by Pitts, Gilbert & Pitts on the shore of the island, near the dam. Two shops were also erected near this building by S. H. White.

In 1853 two shingle-shops were erected by S. H. White; two dry-houses, one office, and one stable by Dimock & Gould; one stable by W. C. Whitmire, and one dwelling-house each, built, owned, and occupied by the following-named persons, viz: Wm. Young, S. H. White, D. B. Sears, Charles Dunker, John Welsh, M. Steutevant, Harvey Jones, Edward Harris, Joseph Frarich—making nine. These buildings are all near the dam. There are also several lumber-yards near the dam and a few small buildings not enumerated above. In 1846 another dam and mill were built on the north side of the main island. The dam runs from the main island to a small island in the Mississippi. This island is said to be the property of Hiram Pitts. The mill stands on the shore of the main island. Near this mill is a steam planing-mill, erected in 1853 by Sears, Wood & Huntoon. There are also two dwelling-houses near this mill, built by D. B. Sears in 1853. On the small island there is one dwelling-house, one stable, and two warehouses at which steamboats land. All the foregoing depredations are upon the eastern or upper end of the island. Between the improvements before enumerated and the western extremity of the island, where the fortifications are situated, the island is covered with a heavy growth of timber. Near the western extremity of the island there are six shanties, erected by the railroad companies, viz, the Mississippi and Missouri Railroad Company and the Chicago and Rock Island Railroad Company. These corporations have cut the timber across the island a hundred feet wide, and are now at work grading the track for a railroad. I am told it is their intention to occupy a space three hundred feet wide across the island. They are also at work quarrying rock on the island to build a bridge across the Mississippi. These I believe constitute all the depredations, with the exception of the wood-stealing, which I have reported.

I would respectfully urge the Department to retain the *whole island* for the purposes indicated in your letter of January 27 to the Secretary of War.

Should the eastern or upper end of the island be disposed of, or granted to any one, it would (unless the right was reserved) prevent the Department from controlling the water-power necessary for such purpose. The water-power is of great value, probably not less than one hundred thousand dollars.

On the 13th of the same month Mr. Danforth wrote to the Quartermaster-General respecting the above, as follows:

In my report of the 8th instant, made in accordance with your orders of the 25th ultimo, I omitted to state one fact in connection with the erection of all the buildings on the island at the eastern part of the island, opposite the town of Moline, viz, that they are all of a temporary character, and probably were built so in the expectation of being ordered off. I think they all stand upon the land Mr. D. B. Sears is endeavoring to get possession of. I was told by reliable authority, at Moline, that if a grant of a portion of the island was made to Mr. Sears, he had agreed to deed ten acres of it to Mr. Pitts, viz, the ten acres adjoining the dam, and on which the large building erected by Mr. Pitts stands.

The above statements are corroborated by numerous reports and letters from other persons, on file at the War Department, Washington. (See letters to the Secretary of War from Major Sibley, United States Army, August 24, 1854; from George P. Cook, June 9, 1857; J. G. Floyd, United States agent, Keokuk, Iowa, May 15, 1857; reports of J. W. Massie and John C. Mather, November 7, 1857; S. Churchill, Inspector-General United States Army, June 25, 1857, and others.)

In August, 1852, the following letter from Thomas L. Drum, custodian of the island, was sent to Hon. Joseph H. Kuhns, M. C.:

I would recommend to your notice Mr. Spencer H. White, the bearer of this letter. He is anxious to procure a lease from the War Department for a certain number of acres on this reserve; and, as I have charge of the Government property here, he wished my influence in the matter. Having no personal acquaintance at Washington with any one but yourself, you will please pardon me for troubling you in this matter.

My principal object, however, in assisting Mr. White in this matter is that I may thereby protect more successfully the upper or eastern end of this island from the continued depredations of the company who own this water-power. Their dams are constructed of alternate layers of wood and stone, (taken from this island;) consequently the high water and ice carry a portion of these dams away every year, which must be built up again with material taken from this island. So that, for building and repair

ing these dams, they have within the last ten years removed well on to three acres of land belonging to the Department, and worth at least two hundred dollars per acre. And now they are about to cut a new channel between Mr. White's mill and the island shore, for the purpose of making another water-power. To do this they will have to take away a considerable portion of the island, as Mr. White's mill is close on shore. You will readily perceive the great inconvenience under which Mr. White would labor if they are permitted to go on; for neither has any legal right to use any portion of this reserve unless it be granted by the War Department. Mr. White has been established here for several years, and has used the ground opposite his mill as a lumber-yard, to which the Department has not objected. The company are now determined to take by force the ground thus occupied by Mr. White for their own use, which will cut him off from any land privilege whatever. I think the War Department ought certainly to interfere in this matter, as well for the Government as for Mr. White, and I sincerely hope you will use all your influence to accomplish the object in view. Mr. White is a very worthy man, stands high in this community, and one in whom the Department can place all confidence.

Other letters urging this request were written at the same time, and the matter was laid before the Secretary of War, and by him was referred to the Quartermaster-General. The following was the latter officer's indorsement thereon:

The site of Fort Armstrong, Rock Island, is one of the most valuable in our western country for an armory; the whole water-power of the Mississippi River is available. If a western armory is to be established, I would advise that it be placed there. The island is under the control of an agent, who resides on it, and who is under the orders of, and reports to, the quartermaster at Saint Louis. The agent should protect the property from depredations. I would not advise that any part of it be rented or leased.

No further action was taken in this matter, and Mr. Spencer H. White continued to urge his request until the following reply was sent to him:

WAR DEPARTMENT,
Washington, November 1, 1852.

SIR: In reply to your applications of the 19th instant and previous dates for a lease of a portion of the military reserve of Rock Island, I have to inform you that, upon examination, it is deemed to be inexpedient, if not, indeed, beyond the legal authority of this Department, to lease any portion of the land in question.

Very respectfully, your obedient servant,

C. M. CONRAD,
Secretary of War.

SPENCER H. WHITE, Esq.,
Moline, Illinois.

In February, 1854, the following bill had been introduced in the Senate:

[S. 195. Thirty-third Congress, first session.]

IN THE SENATE OF THE UNITED STATES,
February 8, 1854.

Agreeably to notice, Mr. Shields asked and obtained leave to bring in the following bill; which was read twice and referred to the Committee on Public Lands:

A BILL to authorize the sale of Rock Island, in the State of Illinois, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the President of the United States shall be, and he is hereby, authorized to cause "Rock Island," in the Mississippi River, in the State of Illinois, to be sold, under such regulations as he may prescribe: *Provided*, That in no case shall the same be offered in tracts exceeding ten acres.

SEC. 2. *And be it further enacted*, That after the passage of this act, David B. Sears, of Moline, in said State of Illinois, shall be authorized, and it is hereby made the duty of the proper officer to allow said David B. Sears, to enter, at the minimum price of Government land, the upper or east end of said island, so as to include his improvements thereon, and not to exceed in quantity seventy-three acres of land.

SEC. 3. *And be it further enacted*, That there be, and is hereby, granted unto the Chicago and Rock Island Railroad Company, as organized under and by virtue of the laws of the State of Illinois, the right of way, four hundred feet in width, across said island, near the lower end thereof.

The amended bill was very long, but did not differ materially in its provisions from the above. The citizens of Rock Island were still earnestly opposed to the sale of the island, and took measures to prevent it.

On May 10, 1854, the chairman of the Military Committee of the Senate (Hon. A. C. Dodge) wrote to Mr. Davis, Secretary of War, about this bill, as follows:

The bill reported by Mr. Stuart, from the Committee on Public Lands, for the sale of Rock Island, seems to meet with a good deal of opposition on the part of the people in the vicinity, and my attention having been called to the fact that Rock Island, as a military reservation, has heretofore been under charge of the War Department, I regard it as an oversight that our committee did not communicate with you before reporting the bill mentioned. I respectfully ask, for the information of the Committee on Public Lands and the Senate, that you may be pleased to communicate to me your views as to the expediency of selling said island in the manner proposed or any other.

Rock Island, as you are well aware, has long been regarded by a large portion of the people in the Mississippi Valley as an advantageous site for an arsenal of construction, marine hospital, &c., and I would be thankful for any information which yourself or the Quartermaster-General may have it in your power to impart upon this subject generally, looking to the interests of the whole country.

The matter was referred to the Quartermaster-General, and the following was his indorsement thereon:

I consider Rock Island the best position in the western country for a large arsenal and armory for the manufacture of arms, means of transportation, clothing, and other military supplies. If it is not to be reserved for the purposes stated above, I would recommend that it be sold, but in such a manner as to obtain the highest price for the property; the persons who have taken possession of portions of it are intruders, and to allow them to purchase that which they occupy for less than its value would be an inducement to persons to intrude themselves upon all other valuable public reserves.

Mr. Davis's subsequent action prevented the passage of this bill, and the bill itself, and all the reports, letters, and other papers about intruders on the island, which had reached the Secretary of War, led to the following action:

In July, 1854, the following notice was served upon all parties located on the island whose names could be ascertained:

UNITED STATES OF AMERICA,
District of Illinois:

It has been made known to the President of the United States that certain persons have, without authority of law, occupied certain portions of the military reserve attached to Fort Armstrong, and are committing depredations thereupon. I am, therefore, required by the President of the United States, under the provisions of the act of 3d of March, 1807, to remove all persons from that reservation.

Therefore, by virtue of the authority vested in me by law and by the order of the Secretary of War, dated June 2, 1854, I do hereby notify you to remove from the said reservation without delay and to immediately desist from all further depredations thereon.

You will be allowed ninety days' time to remove your property and effects from the island.

HARRY WILTON,
United States Marshal, District of Illinois.

The following correspondence and action on this subject is copied from the records of the War Department, Washington:

To the Secretary of the War Department of the United States:

SIR: The undersigned would respectfully beg leave to call your attention to the notice herewith appended, which is a copy of one served on all persons on the military reservation of Rock Island, July 21 and 22, 1854.

From what we had learned we had supposed the order was intended to apply to the railroad company's interest and those who contemplated bridging the Mississippi River. But having learned from supposed good authority that such was not the intention, we naturally conclude, therefore, it must be designed to rid the upper end of the island of its present occupants.

Permit us, therefore, as citizens of Moline, some of whom have machinery and manufacturing interests on said island, to present an account somewhat historical of the

progress of settlement and improvements that have been made at this point within the past fourteen or fifteen years.

We offer this to show you that we do not feel ourselves *trespassers* in the common acceptation of the term, but to show that to some extent we have been invited to make these improvements by surrounding circumstances, and by so doing try to gain an honest livelihood by our own industry. We also take this opportunity to say that we have never made any pretensions to exercise ownership, or institute a "claim," or in any way or manner to wrest from Government the right of soil, but have and do still hold ourselves in readiness to leave whenever Government shall need occupancy for its own use or wish to dispose of it.

We would first call your attention to an act of the legislature of Illinois, of February 11, 1837, which accompanies this memorial, from which you will perceive that the State of Illinois authorized certain individuals to construct a mill-dam, which was built in the years of 1837, 1838, and 1839.

The United States Government at that time had an agent living on said island, who we believe was daily cognizant of the progress of the erection of the dams, and fully acquiescing in said occupancy.

From that time up to this no person has ever been prohibited by the United States Government or any of its officials from the erection of any buildings for manufacturing purposes connected with the dams that were built pursuant to the act of Illinois heretofore alluded to; but, on the contrary, the resident officers have at various times encouraged the erection of such buildings, and uniformly gave the parties to understand that, inasmuch as Government had acquiesced by their silence in what the State of Illinois had authorized, and had acquiesced further by allowing improvements to be made from time to time on the island, they would not be disturbed in their possessions unless the Government should require it for its own use, which has never obtained any extensive belief.

The idea has been entertained by said occupants that they or their assigns would doubtless have an equal chance as purchasers whenever the War Department thought best to dispose of it, unless Congress should by a special act give a pre-emption to other parties.

We would further state that improvements made have not been of a kind to mar the beauty of the island or in any way to disfigure it, but, on the contrary, have improved its appearance and added to its intrinsic value.

In conclusion, allow us to make the request that, if Government does not design using the upper end of the island, the order for removal be so amended as to permit the owners of the dams and present occupants of the mills and manufactories to pursue their business as heretofore, until such time as Government may want it, either to occupy or to sell.

We are induced to make this request because great pecuniary sacrifice must be made if the order is carried out. But if it cannot be complied with, we are disposed to throw ourselves entirely upon the mercy of our Government, hoping at least that time enough may be given for removal to be effected without entire annihilation of our business prospects.

Moline, Ill., July 26, 1854.

Individuals not on island.

JACOB & JAMES SHAW.
H. J. & H. R. BENSON.
CHAMBERLIN & DEAN.
SMITH & STOUGHTON.
JAMES FERGUS.
A. F. CHAMBERLIN.
ABSALOM B. WILLIAMS, *Postmaster.*
HORATIO G. NOURSE.
JOHN S. SMITH.
R. PRICE.
FERRIS & WATTISONS.
J. S. RICHARDS & ALLEN.
COLBURN & JACKMAN.
A. & T. SHAW.
W. D. BABBITT.
J. W. WAGGONER.
S. W. WHEELOCK.
CHARLES ATKINSON.
JOHN DEERE.
WILLIAM A. NOURSE.
ALEX. F. SWANDER, *Sheriff, R. I. Co.*
J. W. DRURY, *Rock Island.*
N. BELCHER, *Port Byron.*
IRA O. WILKINSON, *Judge 6th Jud. Cir.*
W. C. WAGLEY, *Warsaw, Ill.*

On the island.

PITTS, GILBERT & PITTS.
WHITE & TYRRELL.
PALMER, HIBBERD & CO.
SEARS, WOOD & CO.
W. C. WHITMORE.
DIMOCK & GOULD.

FORT ARMSTRONG,
Rock Island, July 27, 1854.

DEAR SIR: I have read the memorial of Pitts, Gilbert & Pitts and others to the War Department in relation to the machinery on Rock Island, and believe the statements to be substantially correct.

The Department would confer a great favor upon the individuals interested, and materially aid the business interests of this section of the country, by giving a liberal extension of time for them to erect buildings for their machinery upon private property, or allowing them to remain until the Government wishes to sell that portion of the island.

With great respect, I have the honor to be, your obedient servant,

J. B. DANFORTH, JR.,
Agt. Qrm. Dept.

Hon. JEFFERSON DAVIS,
Secretary of War.

MOLINE, ILLINOIS, *July* 27, 1877.

Hon. JEFFERSON DAVIS,
Secretary of War.

The undersigned, in behalf of the citizens of Moline, Rock Island County, respectfully submits the accompanying papers.

Moline is at the head of the island upon which Fort Armstrong is located, three miles from the fort.

The town of Moline contains fifteen hundred inhabitants, and they are all more or less dependent upon the water-power at the head of the island, created by a dam built in 1839.

Although the Government has had an agent upon the island since that time, this water-power has been improved without molestation until the 22d instant, at which time those using the water-power were notified that they must abandon it.

Should they do so, it would prove ruinous to their private fortunes, and soon depopulate the town.

They have been expecting from year to year that Government would sell the island, and they have stood ready to purchase it whenever the Government should be willing to part with it.

They have been induced to believe Government would part with it, because they have seen it advertised for sale twice, and because bills for its sale have been frequently introduced into Congress.

The undersigned asks that the people may continue to improve the water-power, under such restrictions as you may establish.

They will remove all dwelling-houses, inclosures, and improvements of all kinds whatsoever, and add nothing to their buildings, or to their stock of machinery for the use of the power.

They will not, directly or indirectly, cut or injure any of the trees on the island.

In fine, they only ask to run their present machinery, under such regulations as you may establish, and which they pledge themselves to carry out to the letter.

Very respectfully, your obedient servant,

J. M. GOULD.

I am well acquainted at Moline, and know that J. M. Gould is the county judge for Rock Island County.

It would be ruinous to Moline to stop the use of the water-power at the head of the island. By the removal of everything else from the island but the *present* incidents to the improvement of the water-power, I think the object of the Department would be attained.

J. WENTWORTH, *M. C.*

These papers were referred to the Quartermaster-General for remark, and were returned with the following indorsement:

Respectfully returned to the Secretary of War. All persons on the public lands at Rock Island, including the inhabitants of Moline, are there without authority from any one having the right to grant them permission to settle there.

It is the water-power which makes the island valuable for military purposes.

If the persons who now use that power be allowed to continue to use it, I respectfully recommend that they be required to pay a reasonable rent for the grounds and water-power, and be bound by contract to surrender both when required by the War Department.

TH. S. JESUP,
Quartermaster-General, United States Army.

AUGUST 7, 1854

The use of the water-power of the reserve at Rock Island may be permitted as proposed, reserving the right to terminate the permission at pleasure, and with the understanding that it does not extend to either residence or cultivation upon said reserve.

JEFF'N DAVIS,
Secretary of War.

WAR DEPARTMENT, *August* 9, 1854.

In a report made to the Secretary of War some time afterward, by James W. Massie and John C. Mather, there is a copy of an agreement which was made under authority of the above indorsement of the Secretary of War, and which gave a temporary lease of property to the following-named parties upon condition that they would at once vacate the premises occupied by them whenever they were called upon to do so by the Secretary of War, viz: Dimock & Gould, Pitts, Gilbert & Pitts, S. H. White, D. B. Sears, Sears, Wood & Co., Palmer, Hibbard & Co., all of the fractional sections 32 and 29, township 18, range 1 west of fourth principal meridian, at $250 per quarter, payable in advance.

Notwithstanding this agreement, it appears that some of the parties were still active in trying to acquire a title to the lands occupied by them.

It has been shown that Mr. D. B. Sears had a bill before Congress in February, 1854, to grant him the privilege of renting the property occupied by him; that it failed to pass, and that then he entered into the above agreement.

In the following winter, through the influence of Judge Drury mainly, he secured the passage of the following act, (United States Statutes at Large, volume 10, page 843, Thirty-third Congress, chapter 44:)

AN ACT for the relief of David B. Sears.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That David B. Sears be, and he is hereby, authorized to enter the fractional quarter section of land on Rock Island, in the Mississippi River, and State of Illinois, necessary to secure to him the full and complete use of the water-power as now improved and used by him on the north side of said island; they being the east half of the southwest fractional quarter of fractional section twenty-nine, containing twenty-eight acres and ten hundredths, the southeast fractional quarter of the same fractional section, containing four acres and nine hundredths, and the northeast fractional quarter of fractional section thirty-two, containing three acres and twenty-six hundredths, all of which are situated in township eighteen north of the base line, range one west of the fourth principal meridian, upon his paying to the receiver of public moneys at Dixon the minimum price of one dollar and twenty-five cents per acre for the same, upon which a final certificate and patent shall issue as in other cases.

Approved January 24, 1855.

Through this act Mr. Sears obtained the land occupied by him till it was repurchased by the Ordnance Department in 1867, for $145,175.

The following correspondence respecting this act shows that its passage was effected without the knowledge of the Secretary of War, and that had that officer known of it its passage would probably have been prevented:

HOUSE OF REPRESENTATIVES,
January 19, 1855.

SIR: I beg leave to call your attention to the bill of which I inclose a brief sketch. I made no objection to the course indicated by Mr. Washburne, because of the statement, as I understood, made by him that you had been consulted and that the measure met your approbation or acquiescence.

Yours,

CH. J. FAULKNER.

Hon. JEFFERSON DAVIS,
Secretary of War.

WAR DEPARTMENT,
January 19, 1855.

SIR: In reply to yours of this date, I can only say that it was not possible for any one to have understood me as approving or acquiescing in the act to give to D. B. Sears a pre-emption privilege to a part of the military reserve of Rock Island.

I was not consulted, and knew nothing of the introduction of the bill until after its passage. He had no right to enter on the tract, and to escape from removal as a trespasser entered into an arrangement by which he was to remain as a tenant during the pleasure of this Department, and to pay rent until notice should be given him to quit.

This arrangement was made as an act of clemency, and sufficiently shows that no right existed or was asserted by this or any other trespasser to hold the public property as a right resulting from settlement or otherwise.

There has been much correspondence on this matter, and if I had been consulted could easily have shown that no claim existed to a pre-emptor's privilege in this case.

It is as if a person permitted to erect a workshop on one of the public lots of this city should therefore claim the right of purchasing it at a dollar and a quarter per acre.

Very respectfully, yours,

JEFF'N DAVIS.

Hon. C. J. FAULKNER,
Chairman of Committee on Military Affairs.

THE RAILROAD-BRIDGE COMPANY.

A full history of this case would include such a mass of papers and documents, many of which have been printed, that it will not be attempted.

The Chicago and Rock Island Railroad Company completed its road from Chicago to Rock Island in 1854.

The Mississippi and Missouri Railroad Company then built the road from Davenport to Council Bluffs, and when the construction of the latter road was determined upon, it became necessary to construct a bridge across the Mississippi to connect the two roads.*

The Railroad-Bridge Company was organized for this purpose, and the location of the bridge as built is shown on the map of Plate I.

It consisted of a bridge from the Illinois shore to the island, a bridge from the Iowa shore to the island, and an embankment across the island to connect the two bridges, or, more properly, the two parts of the Rock Island bridge.

This name and bridge should not be confused with the bridge of the present day, (1876.) The old bridge has been removed and a new "Rock Island Bridge has been built by the United States at the extreme west end of the island.

In January, 1853, the Railroad-Bridge Company secured the following charter from the State of Illinois:

AN ACT to incorporate a bridge company by the title hereinafter named.

SECTION 1. *Be it enacted by the people of the State of Illinois, represented in the general assembly*, That Joel A. Matteson, Joseph E. Sheffield, Norman B. Judd, and Henry Farnam, their associates, successors, heirs, and assigns, be, and they are hereby, created a body-corporate by the name and style of "The Railroad-Bridge Company," with power to build, maintain, and use a railroad-bridge over the Mississippi River, or that portion within the jurisdiction of the State of Illinois, at or near Rock Island, in such a manner as shall not materially obstruct or interfere with the free navigation of said river, and to connect, by railroad or otherwise, such bridge with any railroad, either in the States of Illinois or Iowa, terminating at or near said point; to unite and consolidate its franchises and property with any and all bridges or railroad companies in either of said States; to fix the amount of the capital stock, to divide, transfer, and increase the same; to borrow money and pledge or mortgage its property or franchises; to condemn, according to law, property for the uses and purposes of said company; to contract, bargain, and agree with any such railroad companies for and in the construction and maintenance of said bridge; to sell or lease said bridge, or the use of the same, or the franchises of said company, to any companies or corporations: *Provided*, That said company shall commence said bridge within two years, and shall complete the same within six years from the passage of this act.

SEC. 2. This act to take effect and to be in force from and after its passage.

Approved January 17, 1853.

* The two companies have since been united under the name of the Chicago, Rock Island and Pacific Railroad Company, and this company now owns both roads.

In addition to the above, it was necessary for the company to secure a right of way across the island.

This right was claimed under the act of August 4, 1852, granting a right of way for railroads, &c., across public lands.

From what has already been said, it is clear that this claim was not a perfectly satisfactory one, because it was not generally granted that the island was "public lands."

There are letters to show that the company was not satisfied with the tenure of the land they occupied. One of these, dated March 8, 1854, from the president of the company, Hon. John A. Dix, to the Secretary of War, (Mr. Davis,) is as follows:

NEW YORK, *March* 8, 1854.

MY DEAR SIR: Great anxiety is felt by the two railroad companies which have their termini at Rock Island in respect to the application which I made to you last fall for a grant of land for a railway track and depot across the island.

An argument has been submitted to you "in behalf of the Railroad-Bridge Company, claiming right of way under the act of August 4, 1852," which appears to me to be conclusive as to an application for a right of way.

The bridge is already commenced; the Chicago and Rock Island Road is open to the Mississippi; the Mississippi and Missouri Road is in progress to Iowa City, and it is of the utmost importance to them all that the application should be disposed of. I am advised that the Commissioner of the General Land-Office has reported favorably upon it, and I desire to ask for it your early consideration.

I am, dear sir, very respectfully, yours,

JOHN A. DIX.

Hon. JEFFERSON DAVIS,
Secretary of War.

Mr. Davis, in a reply dated March 14, 1854, stated that the grant asked for would not be given.

The bridge company had, however, occupied land on the island during the year 1853, and in the spring of 1854 numerous complaints of depredations committed were made by the custodian of the island, Mr. Danforth, by citizens of the adjacent cities, and by visitors to the locality.

The following extract is from a letter from the custodian of the island to the Secretary of War, dated February 8, 1854, viz:

The Chicago and Rock Island Railroad Company and the Mississippi and Missouri Railroad Company have united to build a bridge across the island and across the Mississippi River, and have commenced the work. When I received my appointment I made an examination of the island, and found that those companies had erected two shanties on the island and commenced quarrying rock and hauling earth from the island for building the bridge.

Large quantities of excellent rock, at a distance from the line of road, will be taken, and several acres of superior bottom-land, also at a distance from the line, will be destroyed. Then the erection of shanties on the island must necessarily destroy timber, and the inmates cannot well be prevented from cutting wood. There is no necessity for shanties on the island, and I think none should be erected there.

In consideration of the foregoing facts, what course shall I pursue in regard to the railroad companies?

On the 19th of April, 1854, Mr. Danforth wrote to Messrs. John Warner & Co., railroad and bridge contractors, as follows:

FORT ARMSTRONG, *April* 19, 1854.

GENTLEMEN: You are forbidden to break ground upon the island of Rock Island for the purpose of building a bridge to said island, or a railroad-track across said island, or to use any rock or earth or other materials from said island for a railroad or bridge, or to erect or occupy personally, or through your employés, any buildings upon said island, or to occupy or use any portion of the island for any purpose whatever.

Personal notice to this effect was given to you and to your brother a long time since, but I deem it my duty to repeat it in writing.

Respectfully, yours,

J. B. DANFORTH, JR.,
Agent Quartermaster's Department.

Messrs. JOHN WARNER & CO.,
Railroad and Bridge Contractors, Rock Island.

The following report, dated August 24, 1854, is from Maj. E. S. Sibley to the Quartermaster-General:

WASHINGTON CITY, *August* 24, 1854.

GENERAL: I have the honor, in obedience to your verbal order received yesterday, to make the following report: On the 18th of July last, the day after the marshal of the United States for the district of Illinois reached Rock Island, I showed him the limits of the military reserve of Fort Armstrong, and pointed out to him the trespassers and intruders thereon, thus giving him, as I was directed, the necessary information to guide him in the execution of the instructions he had received from the Hon. Secretary of War. At the head of Rock Island extensive improvements have been made. Strong and well-built dams extend on one side to the Illinois shore of the Mississippi River, and on the other to a small island a few rods distant, and a fine water-power has been produced, a water-power which will render the military reserve extremely valuable for manufacturing purposes on Rock Island and its immediate borders; two or three saw-mills, and a factory for making bedsteads, tubs, and pails have been erected and are in full operation. These improvements are on the military reserve and belong to a company, as I have been informed, of which Mr. Sears is a member, and much sympathy is felt in the city of Rock Island and its vicinity for that gentleman, the first person, I believe, who occupied that part of the island without authority of law, and those engaged with him; but in the case of Mr. Sears it is misplaced, as he was one of the trespassers on the island at the time the United States marshal visited it in the winter of 1839, under the orders of Mr. Poinsett, then Secretary of War, and, as I have been told by Mr. Hilton, the present United States marshal for the district of Illinois, promised to leave it early in the ensuing spring, and issued, in company with other trespassers, a paper, drawn up by him, relinquishing all claims to the lands he then occupied.

The substructure of a railroad to connect bridges to be built across the two branches of the Mississippi River at the lower end of Rock Island is nearly completed, and several acres of land in its immediate vicinity have been scalped, and the earth to the depth of from two to three feet has been taken for its construction, thus disfiguring and injuring to some extent the appearance of the island.

I had an interview while I was in the city of Rock Island with the president and one of the directors of this railroad, both of whom expressed surprise at the summary method that had been adopted to eject the company from the island and to prevent the future prosecution of the work. The president informed me he had thought it probable their right to a passage across the island would be legally contested, and for that the company stood prepared; but with the assurances that had been given to General Dix by the President of the United States, he did not expect to be molested in any other way. The directors of the road were satisfied their acts were legal, and in this conviction they had expended a large amount of money in the construction of the work on the island, and on the bridge leading to it. I inclose herewith a copy of the charter incorporating the Railroad-Bridge Company, granted by the general assembly of the State of Illinois. I do not know how far the railroad company depends on the charter for a warrant to its acts, but I was informed it contends that the State of Illinois, having the right of sovereignty over the island, can, in the exercise of that sovereignty, grant the right of way for a road across it for the public benefit, and that under the charter the company is not and cannot be considered a trespasser.

I regret to state that the military reserve of Fort Armstrong on Rock Island is denuded of timber, almost all the trees of large growth having been cut down and been carried away. A young and thrifty growth of trees has, however, sprung up, and if depredations can be prevented, will in a few years become valuable.

Very respectfully, your obedient servant,

E. S. SIBLEY,
Bvt. Major, A. Q. M.

Major-Genl. T. S. JESUP,
Quartermaster-General, U. S. Army, Washington, D. C.

Finally an application for an injunction against the bridge company was made by the United States district attorney for the district of Illinois.

The case was decided by Judge McLean, of the United States Supreme Court, (6 McLean, 517,) and the motion for an injunction was overruled.

It appears probable that the great importance and vital necessity of this bridge to the community and country, and its great value to the Government in case an armory should be established on the island, had much to do with causing the motion for an injunction to be overruled.*

* A more extended account of this case will be found in the history of the Rock Island bridge, in Chapter V.

The bridge company completed their bridge in 1855, and the railroad companies used it until the new bridge was completed, in 1872.

The railroad company tried afterward to purchase lands on the island, but without success.

Also, some letters written by the officers of the companies in 1858, when the War Department again proposed to sell the island, indicate a fear on their part that the tenure of their right of way would be destroyed in case the island passed into other hands.

ATTEMPTS TO PRE-EMPT THE LANDS ON THE ISLAND — THALES LINDSLEY'S SCHEMES, ETC.

It is stated on good authority that parties who desired to pre-empt the island lands were instrumental in procuring the trial of the legality of the "Railroad-Bridge Company's" right of way. It was known that the company claimed the right of way under the act of August 4, 1852, and this claim was worthless unless the lands on the island were public lands.

If a decision could be obtained in the United States Supreme Court confirming the bridge company's right of way on these grounds, then it would also be a decision having the force of law to make the lands on the island public lands, and subject them to pre-emption. Hence the anxiety and action of the parties who intended to pre-empt to procure the trial.

Soon after Judge McLean's decision, Mr. Thales Lindsley, a person unknown at Rock Island, and said to have been a clerk in the Patent-Office in Washington, appeared at Rock Island, organized a party of "squatters," as they were called, took them over to the island, built shanties, and settled the lands with a view to pre-emption. It does not appear, however, that he filed pre-emption papers with the register of the land-office at Springfield at that time.

Early in 1857, a party of gentlemen, nearly all citizens of the city of Rock Island, acting together, also moved upon the island, occupied and settled the whole of it, and at once filed the necessary pre-emption papers with the register of the general land-office at Springfield, Ill.

The members of this party, the dates upon which they settled and filed their declaratory statements with the register, and the lands occupied by them are shown in the following list:

Date.	Name.	Division of—	Section.	Town.	Range.	Date of first settlement.
1857.						
Apr. 29	J. H. Langley	S. W. fraction	30	18 N.	1 W.	April 21, 1857.
29	Jerome I. Beardsley	S. W. "	30	18 N.	1 W.	July 4, 1855.
29	Henry W. Chamberlin	N. W. "	31	18	1 W.	April 22, 1857.
29	James Lackey	W. part S. W. frac	29	18	1 W.	April 22, 1857.
29	John Corcoran	N. E. frac	31	18	1 W.	April 22, 1857.
29	Ashbury Canaday	N. part N. W. frac	36	18	2 W.	April 21, 1857.
29	Jesse H. Canaday	S. part N. E. frac	30	18	1 W.	April 21, 1857.
29	Michael Sollenberger	N. part N. E. frac	36	18	2 W.	April 21, 1857.
29	Peter Castalo	S. W. frac	25	18	2 W.	
29	Same	N. frac. N. W	36	18	2	April 2, 1857.
29	Same	N. frac. N. E. frac	36	18	2	
29	Thomas Bryant	S. W. frac	25	18	2	
29	Same	N. W. frac. and N. E. frac	36	18	2	April 20, 1857.
May 5	Jesse H. Kennedy	S. W. frac of N. E. frac	30	18	1	April 21, 1857.
5	Hiram Pitts	S. E. frac	30	18	1	Jan. 1, 1850.
9	Jacob Warner	S. W. frac	25	.....	.....	
9	Same	N. frac. of N. W. frac	36	18	2	April 10, 1857.
9	Same	N. frac. of N. E. frac	36	18	2	
9	Cyrus Conkling	S. W	25	.....	.....	
9	Same	N. frac. of N. W. frac	36	18	2	April 10, 1857.
9	Same	N frac. of N. E. frac	36	18	2	

Date.	Name.	Division of—	Section.	Town.	Range.	Date of first settlement.
1857.						
May 15	Henry M. Adams	N. frac. N. E. frac	36	18	2	May 9, 1857.
18	George Evener	S. W. frac	25	------	------	April 22, 1857.
18	Same	N. frac. of N. W. frac	36	18	2	
18	Same	N. frac. of N. E. frac				
June 4	Theron H. Waterman	S. W. frac	32	18 N.	1 W.	April 9, 1857.
4	Same	N. E. frac	31	18	1 W.	
4	William H. Fairclough	W. frac. to S. W	29	18	1	April 9, 1857.
4	Charles T. Church	Fraction	31	18	1	April 13, 1857.
4	Same	"	36	18	2	
4	Thales Lindsley	S. E. frac	30	18	1	April 9, 1857.
4	Same	N. E. frac	30			
4	Leander S. Butterfield	S. W. frac	25	18	2	April 18, 1857.
4	Same	Frac	36	18	2	
(Apr. 22	L. S. Butterfield relinquished in favor of C. F. Calkins.)					
June 4	Christian Raub	N. frac. h	30	18	1	April 9, 1857.
4	Same	N. E. frac	25	18	2	
4	Dudley W. Stewart	S. W. frac	30	18	1	April 9, 1857.
4	Charles F. Calkins	S. W. frac	25	18	2	April 22, 1857.
4	Same	Frac	36	18	2	
15	William Thomas	S. W. Frac. ¼	25	18	2	April 10, 1857.
15	Same	Fract	36			
(Apr. 18	William Thomas relinquished in favor of L. S. Butterfield.)					
June 18	Benjamin C. Smith	N. E. frac. N. E. frac. ¼	31	18	1	April 22, 1857.
	Same	N. W. frac ¼	32			
Sept. 4	Pierce Millard	S. W. S. W. ¼	30	18	1	July 6, 1857.
5	Louita Oliver	S. W. frac. ½	25	18	2	June 1, 1857.

They all received certificates of pre-emption from the register of the land-office in Springfield, Ill., in the following June.

There were some squatters on the island even before Mr. Lindsley occupied the lands; so that there were finally three parties, and in some cases there were two and even three persons building on and trying to occupy the same quarter-sections. This caused some quarreling. One man, Mr. Shaub, of Davenport, who had a house near the present site of the officers' quarters, had his house torn down, loaded on a raft, set on fire, and sent down the river. This caused some alarm in the cities, and it was thought to be an attempt to burn the bridge.

Finally Mr. Lindsley's party was crowded out, and moved away or joined the other party, and those left in possession then made a long, persistent effort to obtain a title to the lands.

The case throughout exhibits the high estimate placed upon the island by all who became interested in it.

Before settling on the island the settlers, or "squatters," as they were called, had consulted Mr. Reverdy Johnson and Mr. Montgomery Blair, of Washington, respecting the status of the lands, and had obtained opinions favorable to the success of their plans. They afterward retained both these eminent lawyers, and also Mr. Abraham Lincoln, then practicing law in Springfield, as counsel.

In the following April (1858) they went to Springfield to prove title and pay for the lands. While they were in Springfield a telegram from the Commissioner of the General Land-Office, in Washington, was received by the register prohibiting further action in the matter, and stating that the island would be sold by the War Department at public auction as a military reservation.

After the return of the party to Rock Island they received notice from the custodian of the island, Mr. J. B. Danforth, jr., to leave, which they did not do, but sent the following petition to the Secretary of War:

PETITION.

To the War Department of the United States:

Your petitioners, citizens of the United States, respectfully submit that they are pre-emptors to all that portion of the island of Rock Island, in the State of Illinois, now offered for sale by your Department.

Your petioners represent that they entered into possession of the several portions of the island now held by them last spring, and soon thereafter filed their pre-emption claims therefor with the register of the land-office at Springfield, Illinois; that during the present month of April your petitioners made affidavit of their claims before said register, with offer of proof and payment as required by law.

The reasons which led your petitioners to make such claims were chiefly from a consideration of the opinion given by Judge McLean, of the United States Supreme Court, in the matter of an injunction obtained by the Chamber of Commerce of Saint Louis against the Missouri and Mississippi Railroad Bridge Company, seeking to restrain that company from laying a railroad-track across this island, which opinion is reported in McLean's United States Circuit Court Reports, volume 6, page 517, &c.

Under this judicial opinion, your petitioners have not scrupled to enter upon and cultivate and improve this land, with a view to make themselves comfortable homes.

Thus acting, under rights extended and sanctioned by the legislative and judicial departments of the Government, your petitioners ask for such favorable consideration of their claims from the War Department as will insure to your petitioners peace and quiet in their titles and possessions.

And, as in duty bound, your petitioners will ever pray, &c.

Dated at the island of Rock Island, State of Illinois, this 15th April, 1858.

J. H. LANGLEY.
JESSE H. KENNADY.
WILLIAM B. O. SKELTON.
JAMES LACKEY.
BENJAMIN C. SMITH.
HENRY M. ADAMS.
CYRUS CONKLING.
HENRY W. CHAMBERLIN.

MR. THALES LINDSLEY'S PROPOSED MILITARY SCHOOL AND GREAT NATIONAL UNIVERSITY AT ROCK ISLAND.

In 1856 Mr. Lindsley projected a plan for procuring a grant of a portion of the island as a site for a great national and State university. He prepared an elaborate pamphlet embodying a prospectus of the institution, many reflections and discussions on the subject, and a petition from the board of trustees for a grant of the necessary lands. The board of trustees included some of the most prominent gentlemen in the city of Rock Island. The following is their petition:

The petitioners set forth that they have associated themselves together for the purpose of establishing a military and civil institute in the Northwest, based upon voluntary and republican principles, and intended to so combine military with civil instruction as to inaugurate an education for the country both national and American in its elements.

Extent of grant.—To aid them in the accomplishment of this desirable and patriotic object, the trustees aforesaid respectfully apply to Congress for permission to establish such institute upon that portion of Rock Island lying west of the line of the railroad which crosses its western extremity.

Location.—This island is situated in the Mississippi River, within the boundaries of the State of Illinois, and is an abandoned military reservation. It contains in all about eight hundred acres, nearly six hundred of which remain unsold. The small fraction of it for which application is made is no longer used or needed for any military or other public purpose.

The course of study proposed for the university was certainly wonderful and unique. It is to be regretted that it was so long that it cannot be copied entire. It embraced one hundred different courses of study, and required for its faculty one hundred professors, several hundred adjunct professors, besides tutors and teachers. It is not surprising that the length of time required to complete the whole course of the

university was placed at sixteen years of "laborious study," for only one of the one hundred courses (the legislative course) included over eighty separate subjects of study, divided into seven parts on subcourses, besides many other subjects, the list of which, the author states, he "has not yet perfected."

Respecting another one of the courses, the author states as follows:

NOTE 1.—The following schools are novel to the universities of the country, and mostly to those of the Continent:

1st. School of domesticity,	Elemental.
2d. School of ceremony,	
3d. School of the militia,	
4th. School of manufactures,	Professional.
5th. School of arts,	
6th. School of arms,	
7th. School of editors,	
8th. School of authors,	
9th. School of politics.	

NOTE 2.—Five of these—viz, domesticity, ceremony, manufactures, (wherein the business only of manufacturing is considered,) editing, and authorship—have never existed in any form as schools. Of the character and scope of many of the others the same is assertable.

Respecting the qualification required for students or cadets, the pamphlet states as follows:

CLASSES OF CADETS.

Able-bodied,	Non-able-bodied,
Regular,	Irregular,
State,	National,
Representative,	Non-representative.

From this exhibit you will observe that, though the great aim of the university is to make representative men, it receives into its halls others—in short, admits married as well as unmarried, old as well as young, feeble as well as strong, &c.

Certainly the restrictions were not rigid. Some necessary funds were raised to enable Mr. Lindsley to visit members of Congress and other influential persons to secure their aid in procuring the desired grant of land. Among others Mr. Lindsley visited Hon. Stephen A. Douglas, and requested his assistance. Judge Douglas's reply seems to indicate that he was by this time tolerably familiar with the numerous schemes for obtaining a title to lands on Rock Island. He said, "For Heaven's sake, sir, draw something thicker than a lace veil over your scheme!" The petition and pamphlet were, however, sent to Congress and referred to the Military Committee of the Senate. The chairman of the Military Committee, Hon. J. B. Weller, wrote to the Secretary of War on the subject, April 21, 1856, as follows:

I take the liberty to inclose herewith the "petition of certain citizens of Illinois, desirous of establishing a military institute, praying the grant of an island reserved by the United States for military purposes, but subsequently abandoned, to aid them therein." And I would respectfully inquire if, in your opinion, the prayer of the petitioners can be granted without prejudice to the public interest.

The reply of the Secretary of War, Hon. Jefferson Davis, dated April 20, 1856, was as follows:

I have the honor to acknowledge the receipt of your letter of the 21st instant, inclosing a petition of certain citizens of Illinois praying the grant of a part of the military reserve on Rock Island on which to establish a military institute, and inquiring if their prayer can be granted without prejudice to the public interest.

Rock Island is considered a very advantageous position for a national foundery, or an arsenal for the construction of wagons, &c., and has been held by this Department with the view of its being ultimately required for such purposes. I therefore recommend that the prayer of the petitioners be not granted.

The petition is herewith returned.

This reply, however, was not conclusive. September 15, November 5, and November 7, 1857, Mr. Lindsley sent to the Secretary of War long and exhaustive arguments setting forth the advantage and honor that the War Department would receive from granting lands to the university; but without success.

These papers were interesting, but are too long to be copied.

ATTEMPT OF PITTS, GILBERT & PITTS TO PROCURE A LEASE OF LAND FOR A LONG TERM OF YEARS, AND OTHER FRANCHISES ON ROCK ISLAND.

By reference to the history of the Moline Water-Power Company, in Chaper VI, it will be seen that, in 1857, Messrs. Pitts, Gilbert & Pitts owned the franchise of what is now known as the Moline Water-Power Company. In that year they made an important attempt to increase the value of their franchise by adding to it lands and certain privileges on the island. The plans they had at that time are interesting and highly important now, for they foreshadowed the subsequent chain of events which has led to the building of the great Rock Island water-power by the United States, and has made the Moline Water-Power Company a partner to its benefits. Their plans are set forth in a letter which urged their adoption, and which was written to the Secretary of War, Hon. John B. Floyd, by the custodian of the island, Mr. J. B. Danforth, jr. This letter is dated March 26, 1857:

SIR: I am requested by Messrs. Pitts, Gilbert & Pitts, the owners of the dam from Moline, Illinois, to the island of Rock Island, in the Mississippi River, to apply to you for certain privileges connected with that water-power, which is owned by the United States on one side of the south branch of the river, and by Messrs. Pitts, Gilbert & Pitts on the other side of said south branch of the river. They desire to remove their present dam and rebuild at a point below, as marked on the accompanying map, and from land which they own on the main shore of the Mississippi River. The present dam owned by them is a temporary affair, which they intend to remove, and they wish to construct a new and permanent one below, at a cost of from $50,000 to $100,000. They ask for a permanent lease, or one for a long term of years, of the pieces of land marked thus "+" on the map, and propose as an equivalent to contract to deliver to the United States, at some convenient point below said dam, water-power not to exceed one-half the power of the stream; to construct a free carriage-bridge across said stream and a free road across the island to the main stream.

They offer the following suggestions as likely to have weight with the Government in deciding the question: It will add one thousand per cent. to the value of the land either for sale or for use. They believe if the United States wish to improve the water-power it will be necessary to co-operate with the owners of the land on the main shore, and that of itself would go far toward absorbing the extra value of the land caused by the improvement of the power. To illustrate:

They say, suppose the amount of land they ask for occupation to be 160 acres, as soon as their improvement is completed the next 160 acres will be worth ten times its present value. In other words, if the next 160 acres is now worth $50 per acre, it would then be worth $500 per acre. The account would stand as follows: 320 acres now worth, say, $50 per acre, $16,000; 160 acres after improvement at $500 per acre, $80,000; or, putting a high value on the 160 acres for which they ask a lease, at $100 per acre, viz, $16,000, which sum would be a small item toward the construction of the improvements they propose to make.

It is greatly for the interest of that region of country that something should be done to bring this power into use, and they ask for no land that they think would at all interfere with any plan the War Department may have for an armory, arsenal, or military school on the island. Nor does their petition interfere with the rights of any individual or of the United States. They also say that this improvement, together with that of Mr. Sears from the small island on the north side of the military reserve, will do more toward improving the navigation of the rapids than the two hundred thousand dollars already expended there by the United States.

The piece of land marked No. 1 in red ink on the map belongs to the heirs of George Davenport, to whom it was granted by act of Congress; and the pieces marked Nos. 2, 3, 4, 5, and 6, to David B. Sears.

They desire to commence their improvements as soon as possible, and it would be desirable to have as early a decision as convenient, which when made can be communicated to me at Rock Island, Illinois.

This letter was referred to Mr. John G. Floyd, United States agent at Keokuk, Iowa, for investigation and report. The following is his report, dated May 15, 1857:

KEOKUK, *May* 15, 1857.

SIR: I herewith return the inclosed map and recommendation of J. B. Danforth, jr., as requested, and have to state that I have just returned from a visit to Rock Island to inform myself upon the subject. I find the whole island in possession of *squatters*, headed by a Mr. Lindsay or Lindley, late a clerk in the Patent-Office at Washington. He and nine other persons, whose names might be ascertained upon an investigation by a proper authority, have taken possession of each fractional division of the island, and have formally filed application at the land-office at Springfield, Illinois, for pre-emption.

Other persons, seeing them erect their shanties and occupy them, have also done the same, claiming that they have the same right as other people. Thus the island is now occupied by about fifteen claimants. The upper end of the island has already been granted to one Mr. Sears, without any reason whatever, upon false representations of services rendered by him to increase the value of the balance of the island to the United States.

I think it altogether inexpedient to grant the request of Mr. J. B. Danforth. It would be giving away the best and much the largest part of the island to those men, without any advantages to the United States whatever.

Very respectfully, your obt. svt.,

JOHN G. FLOYD,
United States Agent.

Col. J. J. ABERT, *Top. Bureau, Washington.*

No further action was taken in regard to the application of Mr. Danforth at that time. Messrs. Pitts, Gilbert & Pitts, on the 16th September, 1857, addressed the following letter to the Secretary of War, Hon. John B. Floyd:

DEAR SIR: Rumors of a contemplated sale of the island of Rock Island, in the Mississippi River, being current, we are induced to address you upon the subject, and would respectfully represent that, some ten years ago, we purchased the water-power on the south side of the island and lying on the main shore on the Illinois side, and at heavy outlay and cost, since that period, have improved the same by the construction of dams and the erection of mills and manufacturing establishments; that we now contemplate further improvements, all of which materially add to the value of the island; that to perfect such improvements (which have already cost us some seventy-five thousand dollars) it is necessary to occupy a portion of the island.

We would therefore ask that, in case a sale of the island is contemplated, we may be secured the avails of our expenditures by the privilege of purchasing that portion adjoining the same, viz, the S. pt. of N. W. quarter of fractional section 32, to. 18 N. of range 1 west of fourth principal meridian, containing 83.03 acres, by paying a fair price for the same, to be appraised at its just value, exclusive of the improvements made by us, or by any manner that may be concluded by the Department.

In making this statement, however, we disclaim any desire or attempt to interfere with, prejudice, or vitiate any claims of Major Thales Lindsley, a gentleman, scholar, and civilian, who has, under the decision of Justice McLean, formally caused the whole island to be pre-empted; and claims that, if successful, he will, under patriotic motives, at once found a civil and military school, American and national in its character and aims, and devote one-half the tract to its endowment.

We could not in honor desire to place any obstacle in his way of obtaining legally what he claims in the premises.

[Indorsement.]

FORT ARMSTRONG, ROCK ISLAND, *Sept.* 18, 1857.

I am acquainted with Messrs. Pitts, Gilbert & Pitts, who are very respectable and enterprising citizens, and own the property to which allusion is made in their letter.

J. B. DANFORTH, JR.,
Agt. Qrmr. Dept., U. S. A.

The further history of this case will appear in an account of the proposed sale of the island in 1858.

PROPOSED SALE OF THE ISLAND BY THE WAR DEPARTMENT IN 1858.

Numerous letters from many sources were received by the War Department, Washington, urging that steps be taken to protect the island

and its property from intruders and their depredations thereon. As these letters had some influence in leading the Department to consent to the sale of the island, a few of them, possessing also some interesting history of the island at this period, are copied here:

FORT ARMSTRONG,
Rock Island, October 8, 1855.

SIR: The barracks and one block fort at this place were destroyed by fire yesterday (Sunday) afternoon. I was in the city at church at the time the fire originated. I immediately rallied about a hundred men with buckets, and endeavored to quell the flames, but to no purpose. We had no fire-engine, and it was impossible to stay the progress of the conflagration. The buildings were fired by some persons to me unknown, and in the following manner: About thirty kegs of powder had been stored in the magazine by the contractors for the improvement of the rapids, by permission of the Secretary of War. The magazine had several times been broken open and powder stolen. It was then stored in a safe room, or what was believed to be safe, in the barracks. It had all been taken away, except one keg and one or two parts of kegs. Some persons, while I was at church, had broken open a window and ignited a part of a keg of powder, thus causing the loss of the buildings.

I have published an advertisement (at my own expense) to endeavor to find out the perpetrators of the outrage, which I hope will meet your approval. I send you a copy of my paper, containing the advertisement and an editorial notice of the fire.

Very respectfully, your obt. servt.,

J. B. DANFORTH, JR.,
Agt. Q. M. Dept., U. S. A.

Maj. D. H. VINTON,
Quartermaster, U. S. A., Saint Louis, Mo.

FORT ARMSTRONG, *October* 9, 1856.

SIR: I have to report that on Monday evening, the 6th instant, a very heavy fire occurred at the eastern end of the reserve, destroying the large tub and pail factory, planing-mill, and several other buildings, standing upon ground rented to the owners of these buildings by order of the Secretary of War. I have given to Messrs. Dimock & Gould, the principal losers, permission to erect two temporary wooden buildings upon the ruins, that they may be enabled to pursue their business and save themselves from further ruin. I send you a copy of the permission, which is subject to the provisions of the lease, which binds them to remove all their buildings as soon as notified so to do by the United States. I also send you slips cut from my paper giving a more minute account of the fire.

Hoping you will not disapprove of what seems to me to be justice to the parties, I remain your most obt. servt.,

J. B. DANFORTH, JR.,
Agt. Qrmr. Dept., U. S. A.

Maj. G. H. CROSMAN,
Quartermaster, U. S. A., Saint Louis, Mo.

FORT ARMSTRONG,
Rock Island, Ill., April 17, 1857.

SIR: Your instructions of the 1st instant, directing the unoccupied buildings on the reserve to be pulled down, were duly received. You also direct me to call on the United States marshal for this district to remove all squatters.

One of the unoccupied buildings has been removed and the other taken possession of by W. C. Wilson, who now occupies it with his family.

I have notified them all to remove from the reserve, and have written to the United States marshal as directed.

I do not, however, expect he will pay any attention to the request, as he refused on a former occasion, saying that his orders must come from the proper authorities at Washington, through the district attorney.

The trespassers now on the reserve are Jacob Warner, George Evener, Thomas Bryant, Peter Costello, W. C. Wilson, and Charles Patch.

There is no doubt that they intend to remain on the reserve until they are legally compelled to remove, which ought to be done with as little delay as possible.

Very respectfully,

J. B. DANFORTH,
Agent Qrmr.'s Dept.

Maj. G. H. CROSMAN,
Dept. Qrmr. General, Saint Louis, Mo.

[Indorsements on the above letter.]

Respectfully referred for the information of the Quartermaster-General.

G. H. CROSMAN,
Dept. Qrmr. General.

SAINT LOUIS, April 21, 1857.

Respectfully submitted to the Secretary of War, in connection with my report of the 19th inst., and I recommend that the proper civil officers be required to remove the trespassers from the Rock Island reserve. These officers have not, it seems to me, been very prompt in the performance of their duties when called on to remove squatters.

THOS. S. JESUP,
Q. M. Genl.

DAVENPORT, IOWA, *June* 9, 1857.

SIR: Some days since Major Floyd consulted me about the settlers on Rock Island who seek to pre-empt the vacant land thereon.

We both agreed that they would do no material injury to the island, unless they commenced cutting the timber, in which case I promised to advise Major Floyd.

I learned yesterday that these settlers were hewing down the beautiful young timber on that island, and selling it off for wood. I have written Major Floyd at Keokuk, but do not know that he is there, and, under the circumstances, I conclude to advise your Department of what is going on.

The agent, Mr. Danforth, is cognizant of *all* that is going on, and, so far from endeavoring to prevent it, is more than suspected of aiding the trespassers.

Truly yours, &c.,

JNO. P. COOK.

Hon. JNO. B. FLOYD,
Secretary of War.

[Indorsement on the above letter.]

Respectfully returned to the Secretary of War. I consider it my duty to ask that measures be immediately taken to secure the public property. The property at Rock Island is squatted upon by any who choose to enter upon it, utterly regardless of the agent in charge of it. I have often endeavored to have it protected, but this purpose failed. The civil officers have been appealed to, but it is impossible to get them to act. The laws authorize the President to remove intruders upon the public land by military force. Unless that authority be exercised, the property at Rock Island, which is worth more than a million of dollars, will be lost.

I submit, in connection with this subject, a note from General Churchill, Inspector-General of the Army, dated the 25th of June, with copies of two reports from the agent of the Department, J. B. Danforth, one dated the 1st of June and the other the 1st of July, both submitted by Lieut. Col. G. H. Crosman, department quartermaster-general at Saint Louis.

TH. S. JESUP,
Q. M. General.

JULY 13, 1857.

FORT ARMSTRONG,
Rock Island, June 1, 1857.

SIR: There are now about twenty persons who have erected small houses upon the reserve, and have filed papers at the Springfield land-office, claiming the island under the pre-emption law. They are cutting the young timber and beginning to make gardens.

Immediate and decisive action should be taken to have them all removed and the rights of the United States preserved.

This can be done by suits for trespass or suits in ejectment; but a more effective way would be to send a company of infantry, on its way to or from Fort Snelling, to the island and remove them all.

In the mean time (should suits be commenced) an injunction to restrain them from cutting timber ought at once to be procured.

Should the military company be sent, this would be unnecessary.

I think the interests of the United States require immediate action.

Very respectfully, your obedient servant,

J. B. DANFORTH, JR.,
Agt. Qrmr. Dept., U. S. A.

Col. G. H. CROSMAN,
Deputy Quartermaster-General, U. S. A., Saint Louis, Mo.

[Indorsements on above letter.]

Respectfully referred for the information of the Quartermaster-General.

The island should be either occupied promptly by a detachment of United States troops, or sold to the highest bidder after a survey and subdivision of it into small lots

G. H. CROSMAN,
Deputy Quartermaster-General.

SAINT LOUIS, *8th June*, 1857.

Respectfully submitted to the Secretary of War, in connection with my report on the letter of J. P. Cook, esq., of Davenport, Iowa, of the 9th of June.

TH. S. JESUP,
Quartermaster-General.

JULY 13, 1857.

INSPECTOR-GENERAL'S DEPARTMENT,
Washington, June 25, 1857.

GENERAL: I have just received a letter from a friend in Chicago, from which I make the following extract for your information. I leave here to-morrow for New York, and must take the letter with me. He says:

"On a trip to Iowa a few days since I noticed that there are squatters locating themselves on Rock Island, and was informed that they were making sad havoc with the groves of timber on the island, cutting and selling cord-wood, &c."

I have the honor to be, sir, very respectfully, your obedient servant,

S. CHURCHILL,
Inspector-General.

General T. S. JESUP,
Quartermaster-General.

[Indorsement on above letter.]

Respectfully submitted to the Secretary of War, in connection with my report on the letter of J. P. Cook, esq.

TH. S. JESUP,
Quartermaster-General.

JULY 13, 1857.

FORT ARMSTRONG, ROCK ISLAND, *July* 1, 1857.

SIR: Depredations still continue to be made upon the reserve, and the trespassers are cutting large quantities of wood and destroying the timber and clearing the land.

Some immediate and decisive action should be taken by the War Department to protect the rights and property of the United States.

That a sale of the island would be greatly for the interests of the people of this region there can be no doubt, unless the Department intends the island for an armory, arsenal, &c., as heretofore recommended to Congress by the Secretary of War.

If the Department intends to reserve it for the use of the Government, it might now be made a recruiting rendezvous and thus clear it of all trespassers.

This kind of a military occupation would create no hostility, and would satisfy the people that the Department intended ultimately to improve it for Government purposes.

Inclosed please find my pay-account for the quarter ending on the 30th ultimo.

Very respectfully,

J. B. DANFORTH, JR.,
Agt. Qrmr. Dept., U. S. A.

Lieutenant-Colonel G. H. CROSMAN,
Deputy Quartermaster-General, U. S. A.

[Indorsements on above letter.]

Respectfully submitted for the information of the Quartermaster-General.

I have heretofore recommended action in this matter.

G. H. CROSMAN,
Deputy Quartermaster-General.

SAINT LOUIS, *July* 6, 1857.

Respectfully submitted to the Secretary of War in connection with my report on the letter of J. P. Cook, esq.

TH. S. JESUP,
Quartermaster-General.

JULY 13, 1857.

MOLINE, ROCK ISLAND COUNTY, ILLINOIS,
February 27, 1858.

SIR: There are some facts in the history of the island of Rock Island which are beyond doubt unknown to you. I take the liberty and task of communicating some of them to you.

You have ere this received well-authenticated information that divers persons have

devastated a portion of the military reservation on Rock Island. I beg leave, sir, to call your attention to one of these depredators—to David B. Sears, of this city—who has far exceeded all others in the extent of his depredations. He began his serious encroachments in the fall of 1856, by cutting and removing valuable timber from the west half-section 29, township 18 north of range 1 west of the 4th principal meridian, said tract being a portion of the military reservation, and containing $55\frac{98}{100}$ acres.

The said David B. Sears continued his depredations through the winter of 1856-'57, and desisted only when he had made a clean sweep of the timber on the tract. He removed not less than seven hundred (700) cords of superior cord-wood and a large number of valuable logs.

He caused the greater part of the cord-wood to be hauled to the line of the railroad crossing the lower extremity of the island, and sold it to Mississippi and Missouri Railroad Company, while a smaller part he either used himself or sold to the citizens of this city and vicinity. The logs he caused to be hauled to his mill, and there they have been sawed into lumber, the proceeds in every case returning to himself.

The railroad company are now, and have been for some time past, removing the wood sold to them by D. B. Sears from the island.

All this has been done and is doing under the very eye of the Quartermaster's agent, Mr. Slaymaker, and, so far as can be ascertained, is unrebuked and unnoticed by him. The agent lately appointed has taken no more notice of this than did his predecessor.

Therefore, now, sir, your attention is respectfully called to the facts above noted.

Allow me to add that in the interim between the beginning of his depredations and the present, he, David B. Sears, has publicly said repeatedly that the said tract is his own, or the same as his own. Further, he has laid out a town, and allows and directs his engineer to so plot it that one-half of his proposed town lies upon the reservation. For proof see map of Moline, (last edition.)

If, sir, any reference be desired, I would respectfully refer you to Major Thales Lindsley, of this city, who has resided in this city and vicinity for several years, and whose integrity is above reproach, and whose honor is without a stain. In communicating the above facts, &c.,

I have the honor to be, very respectfully, yours,

H. G. POST.
D. G. SWANDER.
O. A. WHITCOMB.

Hon. JOHN B. FLOYD,
Secretary of War.

[Indorsement on foregoing letter.]

Respectfully returned to the Secretary of War. The robberies committed upon the public property at Rock Island have been going on for years past. I recommended that measures be adopted to put a stop to them, and to recover the value of the property heretofore taken off or used.

TH. S. JESUP,
Q. M. General.

MARCH 19, 1858.

Also see petition to the Secretary of War from J. H. Langley and others, pre-emptors on the island, copied some pages back.

Some of these letters and many others about the island, written in 1856 and 1857, evince a bitter rivalry between the different parties who were trying to acquire a title to lands on the island. The statements made by these parties respecting each other are not always charitable, and appear sometimes to be incorrect.

By referring back to the efforts of several parties to pre-empt the lands on the island, it will be seen that when these parties went to the register at Springfield in April, 1858, to prove title and pay for the lands they had registered, they were told by the register that he had received orders from Washington to stop all proceedings in regard to the pre-emption of the lands, as the War Department had determined to sell the island as a military reservation.

From this time to May, 1858, which was the time finally fixed upon for the sale, all parties having or claiming interests in the island were active in trying to protect those interests.

The following statement of the several interests centering in the island at this time is drawn from various sources, and is believed to give a correct idea of the existing condition of affairs.

There was a party of speculators in eastern cities who desired to purchase the island, and they used their influence to procure its sale, that they might profit thereby.

The numerous complaints of depredations on the island, the persistent attempts of many persons to obtain the lands, the inability of the Government to protect its interests, and the fear that the island would eventually be obtained by its many claimants, and that the Government would receive little or no remuneration for it, finally led the War Department to consent to its sale, although the opinion was almost universal that it ought to be retained as a site for a great armory and arsenal.

There were at the east end of the island several mill-owners and others occupying lands which they had leased from the United States in 1854, with the consent of the Secretary of War, and for which they were paying rent. Excepting from these Mr. D. B. Sears and the owners of the Moline water-power, (Messrs. Pitts, Gilbert & Pitts,) none of the others appear to have desired, and there appears to be nothing to show that they attempted to maintain, any interest opposed to the interests of the United States. They were enjoying valuable privileges by and with the consent of the Government, and they desired to hold them as long as they could. If, however, the Government wanted the island as a site for an arsenal or for other purposes, they were ready to remove. If the island was to be sold, they were very anxious, as were also Mr. Sears and Messrs. Pitts, Gilbert & Pitts, to purchase the lands they occupied. They did not object to the sale, but they objected to the sale of the parts they occupied to other parties, and therefore they were deeply interested in the matter and watched closely, in order that if the sale should take place they might protect their interests and purchase the lands they occupied. The plans of the Moline Water-Power Company (Pitts, Gilbert & Pitts) were pretty sure to be interfered with by the sale, and therefore that company was opposed to it. The sale, if it took place, would certainly destroy all the hopes of the pre-emptors, and also all the projects of Mr. Lindsley; therefore all of these were earnestly and directly opposed to the sale, and did all they could to prevent it. The two railroad companies (the Mississippi and Missouri and the Chicago and Rock Island) and the Railroad Bridge Company were not exactly opposed to the sale, but as they claimed not only the lands occupied by them for a right of way, but also alternate sections of land running to their track, they were earnestly opposed to the sale of what they claimed, and wished it to be reserved, possibly because they may have preferred to hold their claims against the United States to risking them with a purchaser. The claim and interest of Hon. Bernhart Henn, agent of the State of Iowa and her assigns, the railroad companies, were the same as those of the railroad companies themselves, and he protested against the sale for the same reasons.

Some of the foregoing interests are best explained by the following letters:

WASHINGTON CITY, *April* 29, 1858.

SIR: Having observed in the newspapers a public notice signed by you, in which you offer for sale the following-described tracts of land, situated on Rock Island, in the State of Illinois, I deem it my duty, as agent of the State of Iowa and her assigns, the railroad companies, to inclose herewith to you a duplicate of a letter this day addressed to the Commissioner of the General Land-Office, in which I claim said tracts of land as inuring to the Mississippi and Missouri Railroad Company under the act of Congress approved May 15, 1856, entitled "An act making a grant of land to the State of Iowa, *in alternate* sections, to aid in the construction of certain railroads in said State;"

and I do hereby formally protest against the sale of any and all of the following-described tracts, the same having already been disposed of by said act, to wit:

	Acres.
S. W. fracl. ¼ of section 25, T. 18 N. R. 2 W. 4 p. m., containing	70.62
N. E. " ¼ " " 25, " 18 " " 2 " " " " "	10.69
N. W. fracl. of N. W. fracl. ¼ of section 31, T. 18 N. R. 1 W. 4 p. m., containing	49.91
N. E. " " N. E. " ¼ " " 31, " 18 " " 1 " " " "	21.45
W. fracl. ½ of S. W. fracl. ¼ " " 29, " 18 " " 1 " " " "	55.49

Trusting that the Government will not complicate the settlement of the claim of said railroad company to these lands by a sale thereof, I have the honor to remain,

Very respectfully, your obedient servant,

BERNHART HENN,
Agent of the State of Iowa and the Railroad Companies.

Hon. JOHN B. FLOYD,
Secretary of War.

NEW YORK, *April* 12, 1858.

SIR: We regret to be under the necessity of calling your attention to a subject of great importance to the commercial interests of the Northwestern and Atlantic States, and to ask your personal action thereon.

We have just seen an advertisement of the War Department, dated the 26th of March last, inviting sealed proposals until the 31st of May next, for the purchase of the unsold land of the island of Rock Island, in the State of Illinois.

In November last Mr. Dix, one of the undersigned, called personally on the Secretary of War and expressed a wish to lay before him the claims of the Mississippi and Missouri Railroad Company, the Railroad Bridge Company, and the Chicago and Rock Island Railroad Company to a right of way and to certain lands on Rock Island under existing laws of the United States. The Secretary was very much occupied in preparing for the approaching session of Congress, and at his suggestion a communication was addressed to him setting forth in detail the claims of said companies. A copy of this communication, dated the 30th November last, is annexed and marked "A." It requests that the land specified therein and the right of way claimed by the said companies may be reserved from any sale which may be made of the public lands on Rock Island; and it was accompanied by the opinion of Judge McLean, one of the justices of the Supreme Court of the United States, recognizing the right of way of the Railroad-Bridge Company in a suit brought by the United States under your predecessor in office for the express purpose of determining the rights of the company in this respect.

On the 11th of March the request that these lands might be secured if a sale of the island was contemplated was renewed, and it was also requested in that case that Mr. Dix might be advised, in order to afford him an opportunity of seeing the Secretary of War personally. This communication, a copy of which is annexed and marked "B," was addressed to the Secretary in consequence of prevailing rumors that the island was to be sold.

On the 27th of March a third communication, a copy of which is annexed and marked "C," was addressed to the War Department, asking whether the lands claimed by the companies would be reserved from sale.

To no one of these communications has any reply been received.

The three companies in whose behalf the communications referred to were made have invested nearly eleven millions of dollars in these two railroads, and in the bridge across the Mississippi River connecting them with each other. The Atlantic States, including Maine and Pennsylvania, and the intermediate States from the coast to the Mississippi River, have a deep interest in these improvements and in the continuance of the communication across Rock Island. Under the advertisement of the War Department not only the lands claimed by the Mississippi and Missouri and the Chicago and Rock Island Railroad Companies are proposed to be sold, but even the right of way recognized by the Supreme Court of the United States (through one of its justices) as possessed by the Railroad-Bridge Company in a suit instituted for the purpose of settling this very question.

Under these circumstances (on which the undersigned desire to make no comment) we respectfully ask you, as Chief Magistrate of the Union, that the lands, including right of way, claimed by the said companies may be reserved from the proposed sale of Rock Island until their rights therein can be judicially determined; or, should you prefer it, we should be equally well satisfied to have the whole subject referred to the Attorney-General of the United States for his opinion.

Respectfully asking your early attention to this communication, we are your obedient servants,

JOHN A. DIX,
Prest. Miss. & Mo. R. R. Co.
HENRY FARNAM,
Pres. of C. & R. Island R. R. Co., Pres. of the Railroad-Bridge Co.

His Excellency JAMES BUCHANAN,
President of the United States.

The letters to the Secretary of War, copies of which were inclosed in the above letter, are sufficiently explained in the letter itself. The amount of land claimed by the railroad companies was $208\frac{16}{100}$ acres.

WASHINGTON CITY, *May* 24, 1858.

SIR: I have been employed as counsel by J. H. Findley and other persons who claim the right of pre-emption in the public lands on Rock Island, which were formerly included in the military reservation of Fort Armstrong, and which are now advertised for sale by your order on the 31st inst., and in their behalf I beg leave to call your attention briefly to the grounds of their claim, the effects likely to result to the Government and to them from the proposed sale, and to ask that the sale be postponed till the question of their right of pre-emption can be heard and decided in the Department of the Interior.

Mr. Justice McLean, in a decision made winter before last on the Rock Island Bridge case, (6 McLean's Reports, 517,) distinguished these lands from those in the Fort Dearborn reserve considered in the cases of Wilcox *vs.* Jackson, (13 Peters, 513,) and of the United States *vs.* Chicago, (7 Howard, 193,) and held that your predecessor, Governor Marcy, had assigned them to the Land Department by his letter of February 11, 1848, in which he said that the said land "is hereby relinquished and placed at the disposal of the Department which has charge of the public lands," and that from and after that date these lands had ceased to be a reserve "through the same authority by which it had been appropriated," and that the lands thus retroceded to the Land Department were on the same footing with other public lands, and were subject to private entry after advertisement.

If this decision shall be held to be law by the Supreme Court of the United States, the settlers have undoubtedly the right of pre-emption in these lands, for all public lands that can be thus disposed of are subject to pre-emption by the settlers on it.

This brief exposition of the title of the pre-emption will, I am sure, convince you, if not fully of their rights, at least that they are sufficiently well founded greatly to affect the price of those lands if they are sold before the question of their rights is considered and acted upon by the proper Department, and render it certain that, if the true title passes at the proposed sale, the lands will be sold for much less than their real value, and at a great sacrifice to the public.

This would not be always conclusive against disposing of land by any individual while there was a cloud upon the title, because the vendor would, at least, have the advantage of retaining the purchase-money received in any event, so that the price would be clear gain in case his title failed. But the sales of the Government are practically with warranty of title, although the deeds are in form quitclaims, for in every case of failure of title the money received by the Government is returned.

The pre-emption claim in this case, therefore, should be referred to the Deparment which the law makes the final arbiter of such claims, (see Wilcox *vs.* Jackson, 13th Peters, 513,) and where, I have every confidence, it will be promptly as well as correctly decided, before the land can be sold anvantageously to the Government.

And I think you will be inclined to take this course, even if the public interest did not dictate it, from a sense of justice to the claimants, for the proposed sale will operate to confiscate their lands, even if the doctrine of Judge McLean, which affirms their title, should be maintained by the court of the last resort, because the sale will precipitate them into a ruinous litigation, which will deprive them of the greater part, if not of the whole value, of the lands.

I am, sir, with great respect, your obedient servant,

M. BLAIR.

Hon. JOHN B. FLOYD,
Secretary of War.

WASHINGTON, *September* 5, 1857.

SIR: I visited Washington to-day for the purpose of purchasing the military reserve on Rock Island, in the State of Illinois; but learning from your chief clerk that the probability was that the reserve would not be sold at private sale, I submit for your consideration the recommendation contained in the inclosed note from the Hon. S. A. Douglas.

I have some valuable improvements on the reserve, situated on the E. half of the N. W. fract. quarter of section 32, which fraction, as you will perceive by the inclosed map, contains only $37\frac{34}{100}$ acres. I have had peaceable possession of said fraction since the removal of the garrison from Fort Armstrong, a period of nearly twenty-two years, and now occupy it under lease from the Government, (which lease expires at the will or convenience of the Secretary of War.)

Now, to save to me my improvements, (which are of great value to me and would be of but little value to the Government,) I respectfully petition that you sell to me said fraction of land at private sale, or so much thereof as will secure to me my improve-

ments, and at a price as much above the valuation set upon it by your Commissioner as the residue of the lands bring at public auction above said valuation.

Very respectfully, your ob'd't serv't,

DAVID B. SEARS.

Hon. JOHN B. FLOYD,
Secretary of War.

CHICAGO, *September* 2, 1857.

SIR: This letter will introduce to you Mr. David B. Sears, of this State, who resides upon Rock Island, and owns a part of the island by virtue of a grant from the United States. He, in common with the people of that vicinity, feels an interest in having the island sold and connected with private property. It has been abandoned for military purposes several years, and is now lying vacant, without being used for any useful purpose. I would recommend that the War Department send out an engineer, and have all the lands belonging to the United States on the island surveyed into blocks not exceeding four acres each, and surrounded by streets, and then sold at public auction to the highest bidder, after giving at least three months' public notice of the time and terms of sale in the newspapers at Rock Island and Davenport, and the other principal cities of the Northwest.

It might be well, also, to have each block valued by the engineer before the day of sale, and let the valuation stand as a minimum price, below which no bid should be received, as it is probable that most of the blocks would be purchased for private residences by the citizens of Davenport, Rock Island, and Moline. I would suggest that several blocks be reserved, and dedicated on the plot for public squares or parks. I believe this would enhance the value of the residue of the blocks to an interest beyond the value of the blocks so reserved. As the Government has no further use for this island for military or any other public purpose, I think it would be wise to dispose of it in the mode I have indicated. Mr. Sears lives on the island and is familiar with its situation, and can give you all the necessary information concerning it.

I have the honor to be, very truly, your friend,

S. A. DOUGLAS.

Hon. JOHN B. FLOYD,
Secretary of War.

Also see Mr. J. B. Danforth's letter, dated March 26, 1857, presenting Messrs. Pitts, Gilbert & Pitts's interests, which was copied several pages back. Mr. Thales Lindsley also wrote numerous letters to the Secretary of War, pressing his claims, and showing the great honor and benefit that would accrue to the Department by granting him lands, &c., but these letters are too long to be copied. He was opposed to the sale also because of his pre-emption claims.

From the time that it became known that the island was to be sold till near the time appointed for the sale, all of the above parties were active in pressing their claims.

The authority of the War Department to make the sale was derived from the act of Congress of March 3, 1819, (3d volume United States Statutes at Large, page 520,) and the fourth section of the act of March 3, 1857, (11th volume United States Statutes at Large, page 203.)

The sale was advertised as follows:

WAR DEPARTMENT,
Washington, March 26, 1858.

Sealed proposals will be received at this Department until the 31st day of May next for the purchase of all, or any part not less than one legal subdivision, of the unsold land of the "island of Rock Island," in the State of Illinois, heretofore reserved for military purposes.

Bids will be received for the purchase of the lands in gross, or for separate parcels, as above described, the Department reserving to itself the right to accept or reject either or both, as may be deemed most advantageous to the Government.

Bids will be received until 12 o'clock m. of the 31st day of May, at which hour all then before the Department will be opened.

Proposals should be sealed and indorsed, "Proposals for the purchase of the island of Rock Island."

Payment to be made in cash to the assistant treasurer at Saint Louis, or to the Treasurer at Washington, within fifteen days after the acceptance of the bids, and receipts transmitted immediately to this Department. In case of failure to make the payment within the time specified, the award shall be declared null and void.

The descriptions and areas of the unsold tracts into which the island is divided by the surveys, and for which proposals are now invited, are as follows, viz:

Township.	Range.	Section.		Area in acres.
18 N ...	1 W...	29	West ½ of southwest fractional ¼	55.49
18 N ...	1 W...	30	Northeast fractional ¼	14.39
18 N ...	1 W...	30	Northwest fractional ¼	23.55
18 N ...	1 W...	30	Northeast ¼ of southeast fractional ¼	38.31
18 N ...	1 W...	30	Southeast ¼ of southeast fractional ¼	40
18 N ..	1 W..	30	Northwest ¼ of southeast fractional ¼	40
18 N ...	1 W...	30	Southwest ¼ of southeast fractional ¼	25.25
18 N ...	1 W...	30	Northeast ¼ of southwest fractional ¼	40.78
18 N ...	1 W...	30	Northwest ¼ of southwest fractional ¼	40.78
18 N ...	1 W...	30	Southwest ¼ of southwest fractional ¼	40.78
18 N ...	1 W...	30	Southeast ¼ of southwest fractional ¼	39.78
18 N ...	1 W..	31	Fractional northeast ¼ of northeast ¼	21.45
18 N ..	1 W...	31	Fractional north ½ of northwest ¼	49.91
18 N ...	1 W...	32	Fractional east ½ of northwest ¼	37.94
18 N ..	1 W..	32	Fractional west ½ of northwest ¼	45.74
18 N ...	2 W...	25	Northeast fractional ¼	10.69
18 N ...	2 W...	25	Southwest fractional ¼	*70.62
18 N ...	2 W...	36	Fractional north ½ of northwest ¼	21.58
18 N ...	2 W...	36	Northeast ¼ of northeast ¼	*30.55
18 N ..	2 W..	36	Northwest ¼ of northeast ¼	*23.69

JOHN B. FLOYD,
Secretary of War.

NOTE.—The "note" of April 25 being incorrect, the following is substituted therefor:
The following-described tracts, viz: S. W. fractional ¼ of sec. 25, T. 18 N., R. 2 W.; fractional N. ½ of N. W. ¼ sec. 36, T. 18 N., R. 2 W.; N. W. ¼ of N. E. ¼ of sec. 36, T. 18 N., R. 2 W., will be sold subject to the claims of the Railroad-Bridge Company, the Chicago and Rock Island Railroad Company, and the Mississippi and Missouri Railroad Company for "right of way" and "depot grounds," amounting to 15.36 acres in the first-named tract, to 3.72 acres in the second-named tract, and 0.42 acres in the last-named tract, as particularly designated and marked on the maps filed in the General Land-Office, with letter of 28th February, 1854, by John O. Sargent, attorney, claiming right of way under the act of Congress approved August 4, 1852, entitled "An act to grant the right of way to all rail and plank roads and macadamized turnpikes passing through the public lands belonging to the United States."

JOHN B. FLOYD,
Secretary of War.

Numerous bids were received under the above advertisement, but they were never opened. A few days after the day appointed for opening the bids, the act of June 12, 1858, was approved, the sixth section of which (see 11th volume United States Statutes at Large, page 336) prohibited such sales, and it was understood that the action that Congress was taking in the matter, and the strong opposition of many parties to the sale, prevented the Secretary of War from completing it.

ANOTHER ATTEMPT TO SELL THE ISLAND.

The following winter, Senator Trumbull introduced a bill (Senate bill No. 487) to provide for the sale of the island. The interests of the various parties and the action taken by them for and against this proposed sale were precisely the same as already described, except that the arena for action was now transferred to Congress. The bill was defeated, and this was the last attempt to sell the island.

A BILL TO INCORPORATE THE UPPER RAPIDS IMPROVEMENT COMPANY OF ILLINOIS.

During the winter of 1859–'60, a bill was introduced into the legislature of the State of Illinois, and referred to the committee on banks and corporations, to grant to the above company the privilege of constructing a ship-canal and certain dams in the south channel of the river at Rock Island. The bill also included the privilege of constructing certain improvements on the lands in the vicinity of the dams, and made grants of land along the lines of the improvements and the canal.

It is not clear from the wording of the bill how much land thus granted would be included, but it was understood to have embraced some of the land on the island. Mr. Thales Lindsley was one of the incorporators, and is said to have been the author of the project and the sole originator of all the plans it embraced.

This scheme was in direct opposition to the plans of the Moline Water-Power Company. That company sent an agent to Springfield to represent their case, and through his influence the bill was defeated.

Prior to this the correspondence seems to show that very friendly relations existed between Mr. Lindsley and the Moline company, and that they were in accord in their plans. The opposition of the Moline company to this plan of Mr. Lindsley, however, seems to have changed these relations, for in the following year, when a bill was brought in the United States court in Chicago against the Moline company, on behalf of the United States, seeking abatement of nuisance, Mr. Lindsley wrote a long and bitter letter, filled with sweeping charges against the Moline company, and sent it to United States Attorney Larned, in Chicago, who had charge of the proceedings on behalf of the United States. It is sufficient to say here that this suit against the Moline company was not tried, but was abandoned or neglected, and apparently forgotten after the breaking out of the war of the rebellion.

THE PRE-EMPTORS.

In December, 1858, Mr. Blair, while acting as attorney for the settlers on the island, had obtained a decision from the Commissioner of the General Land-Office favorable to the case of the pre-emptors.

He then informed his clients that their title to the lands would be made good. It appears, however, that either the Secretary of the Interior had not concurred in the decision of the Commissioner, or else that his views were subsequently changed; for in January following, when called upon for information while the bill was pending for the sale of the island, he wrote a letter which effectually reversed the decision of the Commissioner.

The success of the pre-emptors excited much interest at this time, and was the subject of many articles in the newspapers.

During the year 1859 no further advance was made by the settlers toward obtaining a title to the lands, but they still remained on the island. During the summer of 1859 an indictment against the settlers was obtained in the United States district court, for cutting timber and other acts committed on the island. The cases came up before Judge Drummond, in Chicago, in August, 1859, and the following are the published proceedings:

Indictment for cutting timber, &c., on the island of Rock Island.

These cases involving the pre-empted character of the Government lands on this island came on for trial in the United States court, before Judge Drummond, on Saturday last.

District Attorney Fitch appeared for the prosecution, and J. J. Beardsley, esq., of Rock Island, and Walker & Van Armand, of this city, for the defense.

After a discussion of divers matters of law, it was finally agreed to take a *pro forma* verdict of guilty against defendants Hortel & Milliard, subject to a motion for a new trial, abiding the result of certain actions of ejectment, which are to be brought to determine more fully the rights of the pre-emptors. The question of title or right of pre-emptions remains, therefore, undetermined.

The settlers were well satisfied with the above, for it was their desire that the legality of their pre-emption claims might be tried before the

United States Supreme Court, and it was the opinion of their counsel that in such trial they would be successful and their title established.

Judge Drummond and the United States district attorney earnestly opposed the settlers in their attempt to get possession of the island. In the summer of 1860, nothing more having been heard of further proceedings in the matter, one of the settlers went to Chicago to see Judge Drummond about it, and it was then discovered that the papers in the case were lost, or, at any rate, they could not be found, and nothing further was done that year. In the spring of 1861 the civil war began, and more pressing matters occupied the attention of all concerned.

From the beginning the settlers, who had gone to the island from Rock Island and vicinity, stated that if the Government should ever wish to occupy the island for armory or arsenal purposes they would not prosecute their pre-emption claims, but would at once willingly resign them for the purpose of securing for the locality so desirable an object If, however, the lands were public lands and subject to pre-emption, and were to be acquired in this way by any one, they would not then resign them to others.

When the act of Congress locating the arsenal on the island was passed, in July, 1862, they relinquished their claims, and have taken no action in regard to them since. There is correspondence to show, however, that lawyers and others, who had been interested in the claims of pre-emptors, continued their efforts to obtain a title to the lands till as late as 1868.

The final history of all the efforts to obtain a title to lands on the island was as follows:

The pre-emptors gave up their claims and moved away as soon as the island was occupied by the United States. Mr. Lindsley's various projects and his pre-emption claims were also given up. All of the mill-owners and others having property on the east end of the island (except the Moline Water-Power Company and Mr. D. B. Sears) vacated the premises occupied by them, and moved away as soon as they were required to do so by the United States.

The claims of the railroad company, the Moline Water-Power Company Mr. D. B. Sears, the Davenport estate, and some minor claims of the city of Rock Island, of the city of Moline, and of parties who had purchased land of Mr. D. B. Sears, were settled by purchase and by contracts made in pursuance of special acts of Congress. A full history of the settlement of all these claims will be given in Chapters IV, VI, and VII. All, except the claims of the railroad and water-power companies, were settled through a repurchase by the United States of all the property that the claimants had acquired. The property repurchased cost the Government the sum of $221,035. The claims of the railroad and water-power companies were settled by contracts entered into in pursuance of the recommendations of a board of commissioners and by virtue of certain acts of Congress. The railroad company's contract provided for the removal of its track and bridges, the abandonment of its old right of way, and the construction of a new route across the west end of the island, the expense of which was borne by the United States and railroad company jointly, and gave the company a right of way over the new route. The water-power company's contract required that the company should relinquish its franchises to the United States; that the United States should build and maintain the water-power, and give to the company a portion of the power obtained, free of cost, forever. The construction of the portion of the water power which the contract gave to the water-power company has cost the United States nearly a half a

million dollars. (See full history of these constructions in Chapters VII and VIII.)

These numerous claims against the United States for the Rock Island military reservation had not been settled in 1862.

The following clear and excellent opinion upon the legal status of these claims was given by the Attorney-General of the United States in November of that year. It is of such importance that it is copied here entire:

Opinion.—Rock Island military reservation.

1. The unsold lands of Rock Island, in the State of Illinois, are not subject to pre-emption under the laws of the United States.
2. The reservation of Rock Island for military purposes derives its validity not alone from the act of selection performed by the President, nor from any of the later acts of the Secretaries of War, but primarily from the statute of June 14, 1809.
3. It was not in the power of the President to relinquish that reservation, and thus throw the island back into the general body of the public lands, without the consent of Congress.
4. The facts in relation to the case of this reservation show that the theory that it has been relinquished, and reverted to the body of the public lands, has never been accepted by either the legislative or executive department of the Government.
5. The authority of the decision of Mr. Justice McLean, in the case of United States *vs.* The Railroad Bridge Co., (6 McLean, 517,) questioned.

ATTORNEY-GENERAL'S OFFICE, *November* 8, 1862.

SIR: The letters of the Acting Secretary of the Interior, the first dated 22d August last, and the second dated the 15th ultimo, present for my consideration these questions:

1st. Were the unsold lands of Rock Island, in the State of Illinois, subject to pre-emption under the laws of the United States in the month of April, 1857?

2d. Are they now subject to pre-emption under those laws?

The view I take of the subject presented by these questions relieves me of the necessity of considering them separately. I have given to them the examination and reflection which their importance demands, and I proceed to state my conclusions.

Rock Island, a part of the public lands of the United States, was reserved and occupied by the executive department of the Government for military purposes. This reservation did not originate, as has been supposed, in the letter of the Secretary of War, Mr. Calhoun, to the Commissioner of the General Land-Office, dated March 2, 1825, wherein, having stated that the island is deemed necessary for military purposes, he requested that it be accordingly reserved for such purposes, and that when the reservation was completed, the War Department should be advised of the fact. That letter and the subsequent action of the Land-Office, in giving notice of the reservation to the register having charge of the public lands in the district wherein Rock Island was situated, were but steps stamping with more formal character a reservation which had, in fact, been made years before under the authority of law. For, by various early acts of Congress, the President had been authorized to erect fortifications in such places as, in his opinion, the public safety should require, and to establish trading-houses at such posts and places on the frontiers, or in the Indian country, as he should judge most convenient. And by the act of June 14, 1809, (2 Stats., 547,) an appropriation was made, among other things, "for erecting such fortifications as may, in the opinion of the President of the United States, be deemed necessary for the protection of the northern and western frontiers." Under the general power given him by this act, the President selected a military site on Rock Island, on which Fort Armstrong was built. (United States *vs.* Railroad Bridge Co., 6 McLean, 527.) I am not informed of the exact time when this selection was made; but, according to the letter of General Jesup to the Commissioner of the General Land-Office, the fort was established during the last war with Great Britain, and was occupied in August, 1815. The reservation of Rock Island for military purposes began when that selection was made, and from that time, as the Supreme Court said of another tract of land reserved under the same authority, (Wilcox *vs.* Jackson, 15 Pet., 513,) "it was severed from the mass of public lands."

This selection of Rock Island for military purposes was not, as we have seen, the unauthorized act of the President, but was made in the exercise of a discretion vested in him by Congress. The Constitution vests in Congress the power to dispose of, and make all needful rules and regulations respecting, the territory or other property belonging to the United States. The word "territory," as here used, is held to be equivalent to the word "lands," (United States *vs.* Gratiot, 14 Pet., 537;) and the power to dispose of the public lands under this clause, whether by sale or by appropriation to other uses, belongs to Congress, and not to the President. (United States *vs.* Fitzgerald, 15 Pet., 421; United States *vs.* Nicoll, 1 Paine, 649.) The reservation of Rock Island for military purposes derives its validity, therefore, not alone from the act of selection performed by the President, nor from any of the later acts of his War Minister, but

primarily from the statute which authorized that selection. In Wilcox *vs.* Jackson *sup.*, the Supreme Court say, in reference to the erection of Fort Dearborn: "It would not be doubted, we suppose, by any one, that if Congress had by law directed the trading house to be established, and the military post to be erected, at Fort Dearborn by name, that this would have been authority of law. But instead of designating the place themselves, *they left it to the discretion of the President, which is precisely the same thing in effect.*"

I accordingly assume that the selection of Rock Island for the site of a military fortification, the erection and continued occupancy of that fortification, and the repeated communication of the War Department to the officer having charge of the public lands, expressing a desire and intention to hold that island for military purposes, together with the formal recognition and acknowledgment thereof by the Land-Office, all deriving their validity from the discretionary power vested in the President by the act of June 14, 1809, have the same legal effect to withdraw the island from the body of the public lands, and appropriate it to the specific purpose named, as if it had been done by a special act of Congress.

I do not understand it to be denied that Rock Island was lawfully severed from the public lands, and set apart for military purposes. But it is contended that the President, through the Secretary of War, on the 11th of February, 1848, formally relinquished this reservation, and placed the land at the disposal of the Department having charge of the public lands, and that it thus fell back into the general body of the public lands, subject to entry and pre-emption as such. In meeting this question, I concede that although there is no evidence, so far as I am informed, that the President in fact approved, or even knew, of the letter of the Secretary of War to the Secretary of the Treasury containing the supposed relinquishment, yet the act of the Secretary, in the absence of any evidence of his disapproval, must be accepted as the act of the President. This principle is settled beyond question, and indeed the validity of the acts of the War Department in the selection and reservation of Rock Island depends on it.

Had the President, then, power, by the act of his minister, to transfer to the body of the public lands a tract which had been lawfully and regularly reserved under the authority of an act of Congress for military purposes, and so subject it to entry and pre-emption by settlers under the laws of the United States? I think the statement of this question compels a negative answer. We have seen that the President derived his authority to appropriate this land to military purposes, not from any power over the public lands inherent in his office, but from an express grant of power from Congress to erect fortifications which he might deem necessary for the protection of the northern and western frontiers. It is true that, as the executive head of the nation, he was vested by law with ample power to supervise and control the fortifications so erected, and the lands reserved for their use. He might even, if he deemed it proper, cease to use the fort and lands for purposes of protection or defense, and withdraw from them the forces and military property of the United States. But, in my opinion, he had no power to take them out of the class of reserved lands and restore them to the general body of public lands. It is certain that no such power is conferred on the President in the act under which the selection of a site for Fort Armstrong was made.

It will be conceded, I suppose, that without the authority of Congress the President could not have selected a portion of the public lands, and, by the erection and occupancy of a fort, devoted it to military purposes. In every instance where this has been done, sufficient legislative authority will be found for the act, either in the form of a general statute, such as the act of 1809, or of special enactment. But if the President could not do this without the aid of Congress, neither could he annul the same work without the same aid. The grant of power to execute a trust, even discretionally, by no means implies the further power to undo it when it has been completed. A duty properly performed by the Executive under statutory authority has the validity and sanctity which belong to the statute itself, and, unless it be within the terms of the power conferred by that statute, the Executive can no more destroy his own authorized work, without some other legislative sanction, than any other person can. To assert such a principle is to claim for the Executive the power to repeal or alter an act of Congress at will. When the President, in the exercise of the discretion invested in him by the act of 1809, selected Rock Island as the site of a fort, and expended the money appropriated therefor in erecting the fort, and occupied it as a military station, thus setting it aside as a reservation for military purposes, the power conferred by the act was exhausted, and he had no more authority to recall that reservation and restore the land to the condition of other portions of the public lands not so appropriated, than he would have had to expend the public money in erecting the fort without an appropriation by Congress for that purpose. The withdrawal of the land from the uses to which, under the authority of Congress, it had been appropriated, and its appropriation to other and different uses, would be simply an attempt "to dispose of" it, the power to do which, as we have seen, resides only in Congress. And, as the delegation

of this power cannot be found in the act of 1809, neither do I know of any subsequent act of Congress from which it can be derived.

This view of the Executive authority in the premises seems to me to accord so exactly with the plain and well-accepted theory of the division of powers in our Government, as hardly to require illustration. But it can easily be demonstrated on various grounds that so long as Congress fails to transfer to the executive department the power to dispose (whether by public sale or by right of entry and pre-emption) of that part of the public lands reserved for military purposes, the right of the Executive to exercise that power ought not to be conceded. The appropriation of the public domain, either to public or private use, is eminently an act of sovereign power. It is the exercise of ownership and implies the right of control over the title. It is a conversion of the property of the nation equal in responsibility and gravity with the appropriation of the public money, and derives its authority from the same high source. Under our system, this extreme power resides only in Congress. As the Executive can draw no money from the Treasury but in consequence of appropriation made by law, so he cannot divest the title to a foot of the public lands without the same legislative sanction.

These reservations were usually made for the location of forts and military stations on the frontiers, where the country was but thinly settled and the public lands had but a nominal value. These forts and stations have been abandoned from time to time, because the increase of population around them, removing frontier dangers and converting them into centers of prosperity and wealth, have seemed to render them useless for military purposes. But the same cause has given, in many instances, immense value to the lands attached to them. It is the appropriate function of the Executive to decide how far such military posts may be needed for the public service at the time, and to use or disuse them accordingly. But it by no means follows that it is or ought to be competent for the Executive, or, as it may happen in practice, his War Minister, without the consent of Congress, to decide that the lands reserved for those posts are and will be no longer needed for the public service, and destroy the reservation by making sale of them or opening them to pre-emption like other public lands. It is quite possible that such lands, for reasons already suggested, may have become much more valuable than they were when reserved, and it is not to be supposed that Congress would consent to their conversion to private use through the operations of the pre-emption laws. If this power exists in the Executive, it might well happen that, through the dishonest or mistaken act of his subordinate, the most valuable and important of the military reservations now held by the Government out of the public lands might be sacrificed through the pre-emption laws to enrich some speculative favorite assuming the disguise of a squatter. Even where Congress has authorized the sale of these reservations, we have not been without examples where the public interests have suffered under circumstances creating strong suspicions of official dishonesty. If it be true that the Executive can, of its own will, convert the military reserves into public lands, subject to pre-emption, it must be conceded that the Government holds them by a most precarious tenure. The temptation to fraud and peculation which such a power offers certainly furnishes an overwhelming reason in public policy against conceding its existence.

But it will be found that the view which I have taken of this subject is sustained by the almost uniform practice of the Government in the disposition of military reservations. Where they have become useless for military purposes Congress has almost invariably provided the method of disposing of them, either by directing that they should be sold by the Secretary, or that they should be placed under the control of the General Land-Office, according to circumstances.

The act of March 3, 1819, (3 Stats., 520,) authorized the Secretary of War, under the direction of the President, to cause to be sold such military sites, belonging to the United States, as may have been found or become useless for military purposes, giving to the Secretary authority, on payment of the consideration money, to execute instruments of title in fee. It having been held by various authorities that this act only authorized the sale of military sites which had become useless at the time of its passage, Congress, by the fourth section of the act of March 3, 1857, (11 Stats., 203,) extended its provisions "to all military sites, or to such parts thereof, which are or may be useless for military purposes." The act of August 18, 1856, (11 Stats., 87,) provided that all public lands theretofore reserved for military purposes in the State of Florida, which, in the opinion of the Secretary of War, were no longer useful or desired for such purposes, or so much thereof as said Secretary might designate, should be and were thereby placed under the control of the General Land-Office, to be disposed of and sold in the same manner and under the same regulations as other public lands of the United States. In addition to these general laws, various special acts of Congress may be found scattered through the statute-books, authorizing the sale, in whole or in part, of particular military sites, or appropriating them to other public uses.

A review of these statutes will show beyond question that Congress no more aban-

doned the power to control and dispose of military reservations than they did the same power over the rest of the public lands, and that the method by which, when no longer needed for military purposes, they were disposed of, was just as well defined and settled by Congress as the method by which the general body of the public lands was opened for settlement or sale.

A striking proof of the vigilance with which Congress exercised its power of control over military sites is furnished by the sixth section of the act of June 12, 1858, (11 Stats., 336.) Serious complaint having been made of the manner in which the power of sale of these sites, conferred by the act of March 3, 1857, was exercised, Congress, by the section referred to, repealed all the then existing laws or parts of laws which authorized the sale of military sites which were or might become useless for military purposes, and declared that said lands should not be subject to sale or pre-emption under any of the laws of the United States, with a proviso continuing in force the act of August 18, 1856, relative to certain reservations in Florida.

For these reasons, I am of opinion that the letter of the Secretary of War to the Secretary of the Treasury of the 11th of February, 1848, was without authority of law and utterly void of the effect proposed, and that the island (except those fractional parts granted by acts of Congress to certain private persons) remains a reservation for military purposes. This reservation, in my opinion, included originally the whole of the island. I do not understand that any doubt has ever been expressed that it had this extent; but, if so, a reference to the letter of Secretary Calhoun of March 2, 1825, and the letter of Secretary Cass of September 11, 1835, and the proceedings of the land-officers thereunder, will put such doubt at rest. But even if the island had not in terms been designated as the extent of the reservation, still, under the principle applied in the case of Mitchell *vs.* The United States, 9 Pet., 761, the whole would necessarily be embraced in it.

It follows from this that the island was not subject to pre-emption under the laws of the United States in the month of April, 1857, neither is it at this time, reservations being expressly exempted from the operation of those laws.

If I have thus far treated this question more fully upon general considerations than with reference to the special facts of the case in hand, it is because the principle it involves seemed to me to require a fair examination and discussion. Claiming for the Executive a power, as I think, subversive of the Constitution, this principle, if it be correct, must extend far beyond the case in which it is now invoked, and if it be erroneous, ought to be rejected as a rule of administration.

But there are certain facts disclosed in the papers you have submitted which show that the theory that the Rock Island reservation had been relinquished and had reverted to the body of the public lands was never accepted by either the legislative or executive departments of the Government, not even by the War Department.

1st. Congress treated it as a reservation not open to entry under the pre-emption laws. For it not only did they authorize George Davenport to enter a fractional quarter-section of the island prior to the alleged relinquishment, (private act, April 2, 1844,) but subsequently thereto, by private act of January 24, 1855, (10 Stats., 843,) David B. Sears was granted the same privilege.

2d. The Secretary of the Interior and the officers of the Land-Office repeatedly refused to recognize any right of pre-emption, and never allowed a claim thereto. It is true that the Commissioner of the General Land Office, in a letter to the Secretary of the Interior, dated December 28, 1858, expressed the opinion that the reservation had fallen back into the mass of the public lands. But his official superior, the Secretary of the Interior, in a letter to the House of Representatives, dated January 24, 1859, in response to a resolution of the House requiring as to "the present situation of the military reservation of Rock Island, whether the same has been transferred by the War Department to the Interior Department," &c., after detailing the facts relative to the reservation and alleged relinquishment, and the attempts of the War Department to resume it, declares that "the policy of the War Department in taking measures for the resumption of the Rock Island military reservation after it had become useless as a military post, and that of the department in charge of the public lands in declining any action to sever the island, has been in accordance with the executive policy in such cases, and was, in my opinion, warranted by a sound construction of the laws [illegible]." After suggesting that the legislative power has not provided any law, or prescribed any conditions according to which lands reserved for military purposes [illegible] disposal of the Land Department, [illegible] to the question whether the military reservation of Rock Island has been transferred by the War Department to the Interior Department, [illegible] not been so transferred."— Ex. Doc., 2d sess. [illegible] Vol. No. 51.

3d. [illegible] approved opinion of the 21st August, 1854, [illegible] Rock Island was [illegible] subject to entry as public land, because it was [illegible]

4th. The War Department, since the letter of Secretary Marcy, has repeatedly and continuously exercised acts of control and jurisdiction over the island quite inconsistent with the theory of its relinquishment. True, Fort Armstrong was evacuated in 1836, and has not since been garrisoned; but the buildings which remained after the sale of a portion of them in that year, together with the island, were then placed in charge of an agent, and so continued, at least until the 20th of December, 1858. (Letter Sec. War of that date.) And, in 1850, an order was issued by the Secretary of War to Colonel Mason to sell the reservation, but it was never executed.

In conflict with this almost unbroken current of legislative and executive action and opinion stands the opinion of Judge McLean, in the case of The United States vs. The Railroad-Bridge Company, (6 McLean, 517.) With the highest respect for the opinions of that distinguished and lamented judge, I am compelled to believe that if he had given to the question under consideration a more careful and thorough examination than that opinion indicates, he would have been led to a different conclusion. As the case is presented, this point seems to have been but incidentally before him, and without a complete view of the facts. On page 525 he declares that "the abandonment of Rock Island as a military post, and for all public purposes, was as complete as its reservation had been," and he distinguishes it (pages 527, 528) from the Fort Dearborn reservation, litigated in Wilcox vs. Jackson, upon the ground that the possession of that reservation "for public purposes had never been abondoned."

It is hard to say what effect might have been produced on the mind of Judge McLean if the well-ascertained fact had been in evidence in the case that the Rock Island reservation had remained in the possession of the War Department, and was actually in its possession by its authorized agent, when his decision was pronounced. If that decision had been reviewed by the Supreme Court of the United States, I am not without reason for believing that an opinion more in accordance with the current of its decisions in similar cases would have been the result. It is worthy of remark that the United States, by the Attorney-General, in that case controverted the conclusions which Judge McLean adopted, thereby showing that prior to April, 1857, the Executive Department considered the island a military reservation. And, as nothing has occurred since that time to change its status, a firm adherence to that position is, in my opinion, the plain duty of those who administer the Government.

I am, sir, very respectfully, your obedient servant,

EDWARD BATES.

Hon. CALEB B. SMITH,
Secretary of the Interior.

Extensive prison barracks for prisoners of war were built on the island in the summer and fall of 1863. The construction of the buildings was in charge of Capt. C. A. Reynolds, United States Quartermaster's Department, and were sufficient for the accommodation of 13,000 prisoners.

The prison was under the control of the Commissary-General of Prisoners, Brig. Gen. William Hoffman, and was commanded during the first year after its construction by Col. Richard H. Rush, United States Volunteers, and after that by Col. A. J. Johnson, United States Volunteers.

Dr. Watson, of Dubuque, Iowa, was the surgeon in charge, and he was assisted in his duties by Dr. P. Gregg, of Rock Island, and many other physicians.

The prison-buildings were all turned over to the Ordnance Department at the close of the war, and were used for a time for the storage of material turned in from the armies in the field. They were temporary structures, and nearly all of them have from time to time been removed.

The subsequent history of Rock Island includes the establishment of the arsenal and armory, the settlement of the claims described above, a description of the island, arsenal, and armory, and a history of the work of construction from its commencement to January 1, 1877.

CHAPTER II.

ESTABLISHMENT OF THE ARSENAL AT ROCK ISLAND, AND MAJOR KINGSBURY'S COMMAND FROM 1863 TO 1865.

Act of Congress locating a national arsenal on Rock Island—Board of officers to select a site, determine materials to be used in construction, &c.—History of the work while under command of Major Kingsbury, Ordnance Department—Reports and correspondence relative to lands on the island occupied by private parties and railroad company—Difficulties growing out of the occupation of the island simultaneously for a military prison and by the Ordnance Department for arsenal purposes—Necessity for arranging plans for the work with reference to the future construction of a great national armory and arsenal—The future magnitude of the work foreshadowed—Act of Congress to remove all private parties from the island—Action of commanding officer thereon—Chief of Ordnance visits Rock Island in May, 1865—Controversy growing out of failure of contractor to furnish stone for Store-house A—Description of Store-house A—Major Kingsbury relieved from command of the arsenal, and succeeded by General Rodman—Statement of funds appropriated for, received, and expended at Rock Island arsenal from 1863 to 1866.

An act of Congress, approved July 11, 1862, to establish a national arsenal on the island of Rock Island, in the State of Illinois, and appropriating $100,000 therefor, was the first action taken by Congress for the construction of the Rock Island arsenal. (Copy of the act, *a*, appendix to Chapter II.) The intention of this act was to provide for the commencement of a small arsenal of deposit and repair, similar to the arsenals at Columbus, Ohio, and Indianapolis, Ind., provided for in the same act. Soon after the approval of the act for the establishment of the arsenal, a board of officers, consisting of Maj's F. D. Callender and C. P. Kingsbury, and Capt. T. J. Treadwell, Ordnance Department, was appointed to select sites on the island for the arsenal buildings and to determine upon materials to be used in construction, &c. (Copy of report of officers, *b*, appendix to Chapter II.) The report of his board fixed accurately the site of the large store-house, now known as Store-house "A," at the west or lower end of the island, recommended sites for magazine and other buidings, and the use of the Le Claire (Iowa) limestone in their construction. (To avoid confusion it should be borne in mind that the course of the Mississippi opposite Rock Island is nearly due west; the island itself is nearly three miles long and has an average width of about one-half of a mile.) On the 27th day of July, 1863, Maj. C. P. Kingsbury, Ordnance Department, was assigned to the duty of constructing and the command of the arsenal, and arrived at the arsenal to enter upon his duties on the 13th of August following. The report of the board of officers, referred to above, was approved by the Secretary of War, and on the 27th of July, 1863, the Chief of Ordnance sent a letter of instructions to Major Kingsbury, (*c*, appendix, Chapter II,) inclosing detail drawings of Store-house "A," and directing him to construct the building in accordance therewith, and to comply with the recommendations of the board in regard to the location of the building, the material to be used, &c. The letter specially directs that the Le Claire limestone shall be used. These instructions were complied with, and the store-house was constructed accordingly. Attention is given to this point here because the use of the Le Claire stone was afterward abandoned in the construction of the arsenal, its quality being considered unsatisfactory, and because Major Kingsbury has been somewhat severely criticised for using the stone and also for the location of the building, for its frontage, and for its character. It is clear that the nstructions of the Chief of Ordnance gave Major Kingsbury no option

in the matter, and if there are any defects in the stone and the location and character of the building, he is not responsible therefor, except in so much as he was an officer of the board that recommended them.

Ground for this, the first building of the arsenal, was broken on the 1st day of September, 1863, and the excavation for the basement completed in November of the same year. Temporary shops for use in constructing the arsenal were put up during the winter, and on the 6th of April, 1864, the masonry-work for foundations was commenced. The corner-stone at the northwestern angle of the building was laid on the 20th day of April, 1864. In the stone was deposited a bottle containing copies of three newspapers—the Rock Island Union, the Davenport Gazette, and the Davenport Democrat; a half dollar, (United States coin,) and a paper giving the date of laying the stone, the names of the President of the United States, the governor of the State of Illinois, and the officers at the arsenal. Work on this building was continued during the whole of Major Kingsbury's command, which lasted until June 30th, 1865, and at that time the basement and a portion of the first story was completed. The building is nearly on the site of old Fort Armstrong, and the window-frames of the basement are made of oak obtained from the old fort. No other buildings were commenced during this time, but 700 yards of stone were procured for a magazine.

Major Kingsbury experienced many serious difficulties and vexatious delays in procuring materials, particularly stone, for carrying on his work. This is partly accounted for by the fact that, by law, material had to be purchased under contract. The contract fixed the price in currency, and might last for years. The value of the currency at that time was subject to violent changes, and it is not easy to force a contractor to furnish materials when the price is far below the value.

During all the time of Major Kingsbury's command the military prison was on the island, and frequent conflicts of authority and quarrels occurred between arsenal workmen and troops belonging to the prison-guard. The former were interfered with and hindered by the guards, and troubles occurred in regard to the cutting down of trees and the use of materials.

As was stated at the beginning of this chapter, the act of Congress approved July 11, 1862, was for the establishment of only a small arsenal of storage and repair. It had, however, been a plan and cherished wish of the War and Ordnance Departments and of the officers of the Army of high rank, for several years, to have constructed somewhere in the Mississippi Valley a great arsenal of construction, consistent in character and capacity with the probable future growth, magnitude, and necessity of this part of the country. This plan was not lost sight of, but was prominently in view when the Rock Island arsenal was located, and it was hoped and expected that at some time in the future the Rock Island arsenal would become the great arsenal needed for the Mississippi Valley. This is fully set forth in the reports and letters of Major Kingsbury, as early as 1863, immediately after work at the arsenal was commenced.

The following are extracts from a letter written by Major Kingsbury to the Chief of Ordnance, August 22, 1863:

> Before building operations are commenced on Rock Island, I deem it a matter of much importance to the United States to secure possession of the "Davenport place" which now nearly separates the Government grounds. Its proximity to the arsenal site renders its ownership a necessity, should an extension of the establishment become desirable; and in view of the geographical position of the island and rapid development of the country, that extension may not be far distant.

Again, on October 8, 1863, Major Kingsbury wrote to the Chief of Ordnance as follows:

It is believed that Rock Island was originally selected for a permanent military establishment on account of its isolation, its admirable geographical position with reference to railroad and water communications, and its subjection to the exclusive control of the Government. In addition to an arsenal of construction, it is probable that, at no distant day, a national armory and foundery will be authorized, to meet the military wants of the vast valley of the Mississippi. If the entire island were the property of the United States, there is probably no other point between the Alleghanies and the Rocky Mountains that would combine so many advantages of position and the other requirements for such an establishment. About two hundred acres have been ceded by acts of Congress to two individuals. The patent for one of these grants, amounting to nearly one hundred and sixty (160) acres, was issued in August, 1845, after the death of the grantee, who had occupied and cultivated the land many previous years. This claim extends nearly across the island, so as almost to divide the Government reservation. The other grant lies at the extreme upper end of the island. It is probable that the advantages already received from these grants have already more than compensated for any labor or improvements the parties have added thereto.

I can find nothing in the report from the General Land-Office relating to Rock Island in reference to the right of way given for a railway across the island, and am, of course, unable to ascertain what width of land was granted for the purpose.

If you agree with me as to the present and prospective importance of Rock Island for military purposes, provided the exclusive jurisdiction and ownership of the United States were restored, might it not be desirable to ask Congress for a repeal of those acts, whereby the value of the island for military purposes has been fatally impaired? Could not these lands be condemned for public uses, and appraisers appointed to determine the compensation, if any, to which the parties may be entitled for their improvements? Should these views meet your approval, their adoption might involve an important modification of the present plan, location, and management of the buildings for the arsenal; but as no masonry can be laid during the winter, there need be no delay in building operations arising from the legislation herein suggested.

The future plans for the arsenal are again indicated in a letter of Major Kingsbury's, dated March 21, 1864, in which he earnestly advocates a restriction of the occupation and use of the island by the Chicago, Rock Island and Pacific Railroad Company, discusses their title to a right of way, and recommends that the railroad company be required to provide a wagon-road on their bridge for the use of the Government. (See appendix to Chapter II.)

Again, on the 9th of December, 1864, Major Kingsbury wrote to the Chief of Ordnance on the subject, as follows:

It has been inferred, from the legislation on the subject and from other indications, that the public works on this island were to be of a more extensive and varied character than any other ordnance-depot west of the Alleghanies; and if this idea be correct, it is evident that the buildings should be designed with reference to this fact, as well as to the locality itself and its topographical surroundings. I am informed that the quarters of which the drawings have recently been received here are identical with those erected at Indianapolis and Columbus; thus having no reference to the commanding importance which this position is destined to occupy, nor to the fact that the quarters here will form a conspicuous object from the river and the railroad, as well as from the growing cities on both sides of the Mississippi, in which there are many buildings of much pretension and elegance. Should not some degree of embellishment or architectural effect be given to the structures thus situated, rather than conform them to the simple and severe style which may be appropriate to less important establishments and more obscure localities?

Major Kingsbury made strenuous efforts to procure the removal and the adjustment of the claims of private parties who held lands or other rights and privileges on the island. These letters and reports foreshadow much of what has been done at the arsenal in subsequent years, and give interest to the extracts which have been made from them, and the copies of a few selections from Major Kingsbury's letters and reports which will be found in the appendix to this chapter. Brig. Gen. George D. Ramsay was Chief of Ordnance at this time, and, in pursuance of the plan indicated, he procured the passage of the following act:

AN ACT in addition to an act for the establishment of certain arsenals.

Whereas it is necessary that the Government of the United States should at an early day, for the purpose of the arsenal at Rock Island, in the State of Illinois, provided for in the act passed July eleventh, eighteen hundred and sixty-two, obtain the possession of and title to certain lands, now the property of private persons, upon which to locate the said arsenal, with the grounds and buildings needful for and to make a part of the same: Now, therefore,

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he is hereby, authorized and empowered to take and hold full, complete, and permanent possession, in behalf of the United States, of all the lands and shores of the island of Rock Island, in the State of Illinois, the same, when so possessed, to be held and kept as a military reservation by the War Department, upon which shall be built and maintained an arsenal for the construction, deposit, and repair of arms and munitions of war, and such other military establishments as have been or may be authorized by law to be placed thereon in connection with such arsenal.

SEC. 2. *And be it further enacted*, That if it shall appear upon examination by the Attorney-General of the United States of the titles of the lands on Rock Island taken and occupied by the Secretary of War for an arsenal and other military purposes, as provided in the foregoing section, that any part or parcels thereof are now the property of, and are rightfully possessed by, any individual or corporation as his or their own private property, the value of such private property so taken, and a just compensation for any damages caused by such taking, shall, if mutually agreed on by the Secretary of War and the rightful owner or owners thereof, and approved by the President, be paid by the Secretary of the Treasury to said rightful owner or owners so agreeing, out of the appropriations made or to be made for the construction of said arsenal: *Provided*, That before such payment shall be made, the said owner or owners of such private lands so taken, or such of them as shall agree, shall by good and sufficient deed or deeds, in due form of law, and approved by the Attorney-General of the United States, fully release and convey to the United States all their and each of their several and respective rights in and titles to such lands so taken.

SEC. 3. *And be it further enacted*, That if the Secretary of War shall not agree with any private owner or owners of land so taken for the use of the United States for military purposes, or if any such owner or owners shall refuse to accept the sum to be paid to him or them by the Secretary of the Treasury as and for the true value thereof, or shall from any cause neglect or fail, for the space of twelve months after such taking, to execute and deliver the deed or deeds thereof needful, in the opinion of the Attorney-General of the United States, to convey to the United States the title of such lands taken, there shall forthwith be selected three competent persons, who shall be named and appointed by the President, and shall by him be constituted a board of commissioners, whose duty it shall be to hear the parties interested, who may appear before them upon reasonable notice of time and place, and ascertain the true value of the land taken, and of the several parcels thereof that shall not have been conveyed to or paid for by the United States as hereinbefore provided, and the names and titles of the claimants thereof, if more than one, and their respective interests therein, and what compensation for the taking of their lands is due to each claimant; and the said board of commissioners shall report the same, as early as practicable after their appointment, to the circuit court of the United States within and for the district in which such lands are situated; and in case of a difference of opinion in the said board as to the matters referred to them, the report of a majority of the commissioners shall be held to be the report of the board. And the compensation and expenses of the said commissioners shall be fixed and approved by the Secretary of War, and paid by the Secretary of the Treasury upon his requisition.

SEC. 4. *And be it further enacted*, That the said circuit court, upon the return and examination of the report of the said commissioners, shall, for the parcels of land taken, as to which there appear to be no conflicting claims for compensation, by decree, order the sums awarded by the commissioners in said report to be paid to the person or persons who shall, according to said report, be entitled thereto and who shall apply therefor, and who shall, by writing filed in the said court, waive his or their right to an appeal from the determination of the said board of commissioners, and agree to accept the said sum in full satisfaction of his or their claims for such lands taken by the United States: *Provided*, That if the party entitled and applying as aforesaid, or filing a complaint as hereinafter provided, shall have an estate for life only in said land, or any estate less than a fee-simple, or shall be a married woman, or a minor, or *non compos mentis*, the court aforesaid shall, in its final judgment or decree, make such order for the payment of the said compensation to the party or for its payment into court, and as to the investment of the principal and disposal of the income or interest thereof, as shall be just and equitable, and for the protection of the rights of those interested, in accordance with the rules and practice of courts of equity in cases where a fund in court is to be divided and administered.

SEC. 5. *And be it further enacted*, That any person or persons aggrieved by the doings of the aforesaid board of commissioners, in the estimation of his or their damages, or in the refusal or omission thereof, may, at any time within twelve months from and after the return of said report to the said circuit court, or within three years after the land claimed shall have been taken, make application by complaint in writing to the said court sitting as a court of equity, setting forth the title which he or they may have or claim in said lands taken, or in parcels thereof, and the grievance complained of; and the said court, after reasonable notice to the district attorney of the United States for that district, who shall appear and act for and in behalf of the United States, shall proceed and hear the parties and their evidence according to the course of proceedings in equity, and shall determine what right or title, if any, the complainant or complainants had in and to the parcels of land taken, claimed by him or them, and shall ascertain and by decree fix the sum or sums of money to which, as damages or just compensation for such taking, the complainants, severally or jointly, if they apply jointly, are entitled: *Provided*, That if a complainant in any case shall, in writing or by motion, so request, the value of the land taken, or his interest therein, shall be assessed or determined by a jury upon the law side of the court, upon issues properly framed, under the direction or allowance of the court sitting in equity.

SEC. 6. *And be it further enacted*, That if the attorney of the United States shall so request, the court may, before ordering issues to be framed for a jury, as provided in the foregoing section, require the complainants applying therefor to undertake and to give security satisfactory to the court therefor, that they will pay the costs of court to be taxed by the court, if the verdict of such jury shall not be in favor of such complainants, and for a sum larger than that allowed by the board of commissioners in their report; and the decision of all questions as to the amount of costs to be paid by or to the complainants shall be within the determination of the court at their discretion, and according to the rules of equity practiced in the courts of the United States.

SEC. 7. *And be it further enacted*, That either party may appeal to the Supreme Court of the United States from any final judgment or decree which may be rendered by said circuit court in any case arising under the provisions of this statute, where the amount in controversy exceeds three thousand dollars: *Provided*, That such appeal shall be taken within ninety days after the rendition of such judgment or decree.

SEC. 8. *And be it further enacted*, That in all cases of final judgments or decrees by said circuit court, or on appeal by the said Supreme Court, where the same shall be affirmed in favor of the claimant, the sum due thereby shall be paid either to the claimant or into the circuit court aforesaid, as said judgment or decree may determine, by the United States, out of the money appropriated for the construction and maintenance of said arsenal, on presentation to the Secretary of the Treasury of a copy of said judgment or decree, signed by the presiding judge and certified by the clerk of the said circuit court. And such payments shall be a full discharge to the United States for the compensation and damages due for the taking of the lands in respect of which the said judgment or decree was rendered or made, and shall forever bar any further claim or demand against the United States arising out of the taking of such land. And such payment, or the lawful tender thereof, shall operate as and shall be deemed and held to be a full and complete conveyance of the parcel or parcels of land for which it was made to the United States.

SEC. 9. *And be it further enacted*, That every claim against the United States for the taking of land for public use, as herein authorized, shall be forever debarred, unless within three years from the time of such taking the claim for compensation therefor shall be adjusted by agreement with the Secretary of War, or be settled by an award of the board of commissioners, or presented by complaint or petition to the circuit court of the United States in the district in which the land is situated: *Provided, however*, That the claims of persons who at the time of the taking shall be under the age of twenty-one years, married women, idiots, lunatics, or insane, or beyond seas, shall not be barred if their petition or complaint be filed in said court as aforesaid within three years after the disability has ceased; but no disability other than those enumerated shall prevent any claim from being barred, nor shall any of the said disabilities operate cumulatively.

Approved April 19, 1864.

An official copy of this act, certified by the Hon. William H. Seward, Secretary of State of the United States, was sent to Major Kingsbury, and the Chief of Ordnance directed him by letter, dated May 21, 1864, to take measures at once to carry out the provisions of the law. In reply, dated June 7, 1864, Major Kingsbury informed the Chief of Ordnance that he had conferred with the parties owning or occupying lands and buildings on the island, and that they expressed their willingness to vacate as soon as they should be notified to do so, but that they

desired to remain as long as their occupancy would not interfere with the improvements on the island contemplated by the Government.

On the 14th of June, 1864, the Chief of Ordnance wrote to Major Kingsbury, and directed him to give legal notice to each party in interest to vacate the premises occupied by him before a specified time, but that none should be allowed to remain in occupancy longer than six months, and on the 17th of June, 1864, Major Kingsbury sent such notice to each of the following-named parties, viz:

Messrs. Geo. L. & B. Davenport.
D. B. Sears, esq.
Messrs. Dimock & Gould.
Messrs. Stephens, Huntoon & Wood.
Mr. Robert Welsh.
Mr. James Robinson.
Mr. S. H. White.
Mr. Daniel Jones.
Mr. Peter Peterson.
Mr. David Sears.*

In September, 1864, Messrs. Dimock & Gould made application for permission to remain on the premises occupied by them on the island and continue their business until the Government should require them to move, on condition that they should pay to the United States a fair rent for the premises occupied. This request was granted by the Chief of Ordnance, with the further condition that they should vacate within thirty days after receiving notice to do so. Afterward the same privilege was granted to Stephens, Huntoon & Wood, and, finally, to all.

In September, 1864, General Ramsay, Chief of Ordnance, was retired, and Brig. Gen. A. B. Dyer succeeded him. During the succeeding fall and winter the proposed arsenal at Rock Island was the subject of a good deal of discussion between General Dyer and other officers, and, early in May of the following spring, he visited Rock Island and made a careful examination of it.

It was the privilege of the writer to accompany the Chief of Ordnance on this visit, and to listen to a discussion of the plans for the future great arsenal, the location of buildings and bridges, the use to be made of the water-power, &c.

A good deal of controversy grew out of the failure on the part of the contractor to furnish stone for Store-house A, as required for its construction. As these failures were the cause of the unsatisfactory progress made in the construction of the building, and as the controversy received much attention from outside parties, and, some parts of it, from Congress, and as it is interesting in other respects, it is proper to give a short account of it.

On November 19, 1863, a contract to furnish all the stone required for the building was awarded to Joseph Parkins, of Madison, Wis. The stone was to be the Le Claire limestone, quarried at Le Claire, Iowa; all was to be delivered before August 1, 1864, and the price was to be $7.50 per perch of 25 cubic feet of stone cut ready for laying, and to be measured in the walls of the building.

Only a small part of the stone required was delivered before June, 1864. During this time Mr. Parkins claimed that the price was so low that he was losing money, that prices for labor had advanced greatly, &c. (It is well known that during this time the value of currency had depreciated about 30 per cent.) There was a great deal of correspond-

* I have ascertained what lands were occupied by each of these parties on the island, and they are shown on the map on Plate V.

ence between Major Kingsbury and the Chief of Ordnance on the subject, and, finally, both these officers recommended that the contract be canceled and a new one made. This was ordered by the Secretary of War; new bids were received and a new contract was made with Mr. Parkins, June, 29, 1864, the price of the stone to be $10.50 per perch. This did not mend matters very much. Not much stone was delivered in the fall of 1864; the stage of water in the river was so low that the stone could not be boated down. Mr. Parkins claimed that the price was still too low, and he was losing money; that he was out of funds and could not go on with the contract unless advances of money were made to him, and that he ought to be paid $10.50 per perch for all the stone he had delivered under the old contract, when the price was $7.50 per perch. There was a great deal of correspondence between Major Kingsbury and the Chief of Ordnance on the subject, and Major Kingsbury again recommended an advance in price, but it was not granted. By consent of the Chief of Ordnance, $3.50 per perch was paid to Mr. Parkins for a lot of stone he had quarried at Le Claire, which could not be boated down the river on account of low water, and also the retained percentage on all the stone he had delivered was paid to him. (The contract required that 25 per cent. of the price of the stone should be retained until the completion of the contract.) Some of the other bidders for the second contract protested against a further advance of price to Mr. Parkins, and very reasonably claimed that if a price as high as the bid next greater than Mr. Parkins's was to be paid, then the contract should be taken from Mr. Parkins and given to the second bidder.

In the summer of 1864 Mr. Parkins applied to Congress for relief, and succeeded in having the following resolution passed:

PRIVATE RESOLUTION No. 12.

JOINT RESOLUTION for the relief of Joseph Parkins.

Be it resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the proper accounting officer of the War Department be, and is hereby, authorized and instructed to pay to Joseph Parkins, who has been, and now is, delivering the stone for the construction of the arsenal at Rock Island, in the State of Illinois, in lieu of the contract-price, the sum of thirteen dollars and fifty cents ($13.50) per perch for all stone delivered, and to be delivered, for the construction of said arsenal, and that said Parkins shall receive and accept said sum as full satisfaction of all claims under said contract, and shall never make any further claim for any service rendered by him thereunder.

Approved July 3, 1866.

Major Kingsbury left the arsenal in July, 1864, and the controversy about the purchase of stone continued under General Rodman. Mr. Parkins claimed that changes had been made in the drawings for the walls of the building which caused him increased expense and loss. Also a great deal of difficulty was experienced in arriving at a satisfactory measurement of the stone. The contract stated that the stone should be measured in the wall; the contractor claimed what is termed "builders' measurement," including openings for windows, doors, &c., and increased allowance for projections, moldings, cornice, &c. There was a great deal of correspondence with the Chief of Ordnance on the subject, and finally an agreement was arrived at. The meaning of "builders' measurement" in adjacent cities was determined; the walls of the building were measured accordingly, and a final payment was made to Mr. Parkins, August 13, 1867, by which he received $13.50 per perch for all the stone in the building, as determined by measurement,

previous payments being deducted. After that, in February, 1868, James W. Harvey made a claim against the Government for further payment. His claim was that in the spring of 1865 he had advanced money ($10,000) to Mr. Parkins to enable him to go on with his contract for stone, and without this advance Mr. Parkins could not have gone on with his contract; that Mr. Parkins had finally settled with the United States and gone to parts unknown, leaving him (James W. Harvey) and two others, his creditors for various sums to the amount of $15,000; but that Mr. Parkins had still a good claim against the United States for further sums of money, and Mr. Harvey made application for the payment of these sums to him as a creditor of Mr. Parkins. The sums claimed were:

1st. Three thousand eight hundred and fifty dollars for increased value of stone used on the interior of the walls of the building, which, by contract, should have been used on the exterior only. Mr. Harvey claimed (and it was true) that this sum had been allowed by the Ordnance Department, and Mr. Parkins was credited with it on Major Kingsbury's books. He had seen this credit in the spring of 1865, and it was this mainly that had induced him to advance money to Parkins.

2d. Four thousand five hundred dollars for increased quantity of stone and increased cutting of same, finished by Mr. Parkins for cornice, on account of change of plans made by General Rodman.

After some correspondence this claim was referred to the Second Comptroller of the Treasury, and the following was his decision:

> The increase in the contract-price in this case was provided on condition that Mr. Parkins should accept the sum in full satisfaction of all claims against the Government under that contract.
>
> The extra allowance for outside stone applied to inside work had then been paid, and was not "a claim;" but the increased allowance for the new cornice, not having been paid, "was a claim" that must be considered as returned to the Government by the claimant's acceptance of the terms of the joint resolution in question. A check, in favor of Mr. Parkins, for the $3,850 that was deducted, may now be sent to the care of Mr. Harvey.

In explanation of the above it should be stated that the $3,850 had been paid to Mr. Parkins before the passage of the joint resolution. When the building was finally measured up and final payment made to Mr. Parkins, this $3,850 was one of the previous payments deducted.

Mr. Harvey presented a power of attorney from Mr. Parkins, and the sum of $3,850 was paid him March 21, 1868.

(NOTE.—Briefs and copies of all the papers and correspondence relating to Mr. Parkins's contract have been made and are on file at this arsenal, but are not deemed of sufficient importance for transmission herewith.)

DESCRIPTION OF STORE-HOUSE "A."

Store-house "A" is a rectangular building, 60 feet by 180 feet, with a projection or portico, 14 feet by 60 feet, on the south side, and a tower, 35 feet square, on the north side. The tower is 117 feet high, and provided with good stairways and hoisting apparatus. There are also stairways in the south projection and two interior hoists to all the floors.

The building contains a basement, attic, and three other stories. The attic floor is weak and not available for storage. The three main floors contain about 35,000 square feet of space, and will sustain about 270 pounds per square foot. The floor-joists are wood, laid on wood stringers supported by cast-iron columns, and the roof-truss is wood. The floors are not constructed to be fire-proof.

No name can be given to the exterior architecture. The walls are of buff limestone. All of the exterior is cut or bush-hammered work, and highly ornamented with projections, moldings, &c. The water-table is at the first floor. There is a belt-course at the second floor, another belt-course at the attic or fourth floor, and a frieze, with frieze-windows, and a cornice supported by brackets above that. There are heavy rusticated pilasters at all the angles of the first story, and from the first story to the frieze the pilasters are double and not rusticated.

Since 1871 the building has been used to its full capacity as a receiving and issuing store-house for supplying the Army, and, on account of its proximity to all the railroad-depots and river-wharves in the cities of Rock Island and Davenport, it is well adapted for this purpose. It is well built, and has required no repairs in the nine years since its completion, except that the pediment cornices do not rise above the roof as they should, and, as the exposed position of the building subjects it to violent winds, several squares of the slate-roofing have been stripped off three times in six years. Also, the building has no chimney or ventilating flues, and cannot be ventilated, warmed, or dried in winter.

The tower is supplied with one of the best tower-clocks in the United States. It has a dial 12 feet in diameter on each of the four sides of the tower, and a striking-bell weighing 3,500 pounds. The dials can be read easily from the cities of Davenport and Rock Island. The clock is valuable as a regulator, and in furnishing arsenal time to the arsenal workmen, nearly all of whom live in the two cities; but the dials cannot be read nor the bell heard usually from the other arsenal buildings.

This building is not shown on any of the plates. It was completed in 1867.

At his own request, Major Kingsbury was relieved from the command of the arsenal in June, 1865, and Maj. T. J. Rodman, Ordnance Department, (afterward lieutenant-colonel of ordnance and brevet brigadier-general United States Army,) was assigned to the command. (See Special Orders No. 303, dated War Department, Adjutant-General's Office, Washington, D. C., June 14, 1865.)

Major Kingsbury did not leave the arsenal until the latter part of July, and Major (General) Rodman did not arrive until some time in August. Lieut. J. A. Kress, Ordnance Department, had been assigned to duty at the arsenal by the same order that relieved Major Kingsbury and assigned General Rodman to the command. He arrived at the arsenal in July, receipted to Major Kingsbury for the property, and remained in charge until the arrival of General Rodman.

In taking leave of the arsenal, Major Kingsbury writes as follows:

> Having been ordered hence at his own request, Major Kingsbury transfers his duties to his successor with the hope that the latter will not be tried with the numerous delays and vexations which have attended the period of his connection with the Rock Island arsenal.

The appropriations and expenditures for the arsenal during the period of time embraced in this chapter were as follows:

Funds appropriated for, received, and expended at Rock Island arsenal from 1863 *to* 1866.

Fiscal year ending June 30—	Acts of Congress approved—	Amounts appropriated.	Amounts received.				
			From the United States Treasury.	From sales.	From rents.	By transfer from other appropriations.	Total.
1864	July 11, 1862..	$100,000 00	$40,000 00	.....	.....	.....	$40,000 00
1865	.....	.....	29,000 00	$240 00	$437 50	.....	29,677 50
1866	March 3, 1865..	73,000 00	104,000 00	.....	117 41	$33,785 05	137,902 46
	Total.....	173,000 00	173,000 00	240 00	554 91	33,785 05	207,579 96

EXPENDITURES.

Fiscal year ending June 30—		Construction of buildings, and other arsenal work.	Transferred to other appropriations.	Total.
1864	Disbursements	$28,647 28	.....	$28,647 28
1865	Disbursements.....	31,049 93	.....	31,049 93
1866	Disbursements.....	137,902 46	$9,980 29	147,882 75
	Total	197,599 67	9,980 29	207,579 96
	Expended prior to July 1, 1866	197,599 67	.....	197,599 67
	Outstanding indebtedness July 1, 1866.....	33,785 05	.....	33,785 05
	Total cost of work prior to July 1, 1866	231,384 72	.....	231,384 72

Appendices to Chapter II.

[U. S. Statutes at Large, chapter 148, vol. 12, p. 537.]

a. AN ACT FOR THE ESTABLISHMENT OF CERTAIN NATIONAL ARSENALS.

That there be, and hereby is, established a national arsenal at Columbus, in the State of Ohio, at Indianapolis, in the State of Indiana, and on Rock Island, in the State of Illinois, for the deposit and repair of arms and other munitions of war.

Approved July 11, 1862.

b. REPORT OF BOARD OF OFFICERS APPOINTED TO SELECT SITES FOR BUILDINGS, MATERIALS TO BE USED, ETC.

The undersigned, appointed a board under orders from the Ordnance Office, dated May 6, 1863, to select a site for certain buildings pertaining to the proposed arsenal at Rock Island, respectfully report:

That they have carefully examined the ground at the lower end of Rock Island, selected by the War Department for a United States arsenal, and recommend that the front of the principal store-house be on the prolongation of a line drawn from the southwest corner of a wooden building, now occupied by a tenant; and that the southwest corner of said store-house be placed at a point on this line 300 feet distant from said wooden building, the said line bearing about south 40° west.

They have also selected two sites for a magazine, one on the high ground about 780 feet due east from the short railroad-bridge passing over the southern road, running towards the upper end of the island, and the other on a ridge near the center of the

island and in the vicinity of three graves, each surrounded by a white picket-fence. The latter is preferred if the ground belongs to the United States.

The points selected are indicated on the drawing sent from the Ordnance Office.

Respectfully submitted.

F. D. CALLENDER,
Maj. Ord'ce, U. S. A.
C. P. KINGSBURY,
Maj. of Ord'ce.
T. J. TREADWELL,
Capt. of Ord'ce.

DAVENPORT, IOWA, *May* 18, 1863.

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c.

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, D. C., July 27, 1863.

SIR: The Secretary of War having approved the plan of the main building, or principal store-house, of the arsenal to be established at Rock Island, Illinois, as also the location of the several buildings for that arsenal, recommended by the report of a board of officers dated May 18, 1863, and having assigned you to the duties of constructing and to the command of the arsenal, under instructions from this office, I have to direct that you enter upon those duties and take that command without unnecessary delay. For this purpose you will at once be relieved by Lieut. Col. Whitely from your present duty of inspecting ordnance, &c., at Fort Pitt Foundry, and will turn over to him all books, papers, and public property in your possession, pertaining to that inspection duty. You will then proceed to Rock Island, Illinois, and commence the duties to which you are assigned of the construction of the United States arsenal there. The first building to be erected is the principal store-house, the plan and details of which are shown by the accompanying drawings, (six sheets,) which are sent for your information and government. I also inclose, for the same purpose, copies of the report of the board on the location of the buildings, and memoranda in relation to building materials. The stone selected and preferred for the buildings is the limestone from the quarries at Le Clare, Iowa, a specimen of which will be sent to you at Davenport. Drawings of the other buildings for the arsenal, and a plan showing their relative positions, will be sent to you hereafter. Report to this office your arrival at Rock Island in the execution of these orders.

Respectfully, your obedient servant,

JAS. W. RIPLEY,
Brig. Gen'l, Ch'f Ord.

Maj. C. P. KINGSBURY,
Pittsburgh, Pa.

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d.

DAVENPORT, IOWA, *August* 22, 1863.

SIR: Before building operations are commenced on Rock Island, I deem it a matter of much importance to the United States to secure possession of the "Davenport place," which now nearly separates the Government grounds. Its proximity to the arsenal site renders its ownership a necessity, should an extension of the establishment become desirable; and in view of the geographical position of the island, and the rapid development of the country, that extension may not be far distant. Applications have already been made for permission to place a dwelling and a "saloon" on the reservation, and should this farm be disposed of in lots, there will soon be a congregation of such establishments that must become a perpetual nuisance. Several citizens whom I have consulted have valued the farm at from $10,000 to $12,000, but the owners hold it as high as $600 per acre. This valuation must be due to its supposed relations to the public works, and if such an extravagant estimate is placed upon it now, before these works are commenced, the fictitious valuation which will follow the completion of the arsenal can hardly be predicted. In view of these facts, the possession of the Davenport place, with the arsenal at the lower end of the island, seems, for future security, to become an imperative necessity, and, as such, should be taken by the Government at the valuation of appraisers, if not otherwise to be had. The island was reserved for military purposes because of its extent and isolation, and the means thereby afforded for an ultimate enlargement, untrammeled by private interests. The very end, therefore, designed by the reservation is defeated by individual ownership, and the advantages which the site originally possessed for a permanent military establishment have been comparatively nullified by the unwise transfers to private parties.

There is another matter to which I desire to call your attention. I learn that a bridge is being built from Rock Island City to the island, and, so far as I know, without

authority from the Government, or without inquiry even whether the landing will interfere with the proposed location of the arsenal buildings.

Respectfully, your obedient servant,

C. P. KINGSBURY,
Major of Ordnance.

Brig. Gen. J. W. RIPLEY,
Chief of Ordnance, Washington, D. C.

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e. DAVENPORT, IOWA, *October* 28, 1863.

SIR: The mayor of Rock Island has applied to me to locate a road which the authorities of that city propose to run from the bridge recently completed. To this application I replied I could take no official action in the matter; that the road, if made, ought to run along the extreme southern border of the island above high-water mark, and that I would report the matter to Washington for instructions. It appears to be the intention to make a thoroughfare across the island by the continuation of this road along the western side of the railway. In my judgment this should not be permitted, and no right of way should be given at all without reserving on the part of the United States the absolute right to close such road at any time, and all communications connected therewith.

On the 24th ultimo I suggested to the Department that the ordnance jurisdiction on the island ought to be defined, and in a letter from Chicago, dated the 8th instant, I stated what I consider would be a proper limit to that jurisdiction.

No reply has been received to either communication, and as the island is so encumbered with the supposed tenants of the civil superintendent, whose horses, cattle, and hogs are roving at will over the entire area, it becomes daily more desirable to have the question settled. And if any authority has been given by the War Department for the construction of the railway across the island which was commenced about the year 1852, I request that I may be informed what extent of ground the company was permitted to occupy.

Very respectfully, your obedient servant,

C. P. KINGSBURY,
Major of Ordnance.

Brig. Gen. GEO. D. RAMSAY,
Chief of Ordnance, Washington, D. C.

DAVENPORT, IOWA, *March* 21, 1864.

SIR: Though unwilling to trouble you with another letter having special reference to Rock Island, a sense of duty constrains me to call your attention once more to the subject.

The Solicitor of the War Department, in a recent opinion as to private claims upon the island, is reported by telegraph to have assigned an area of about thirteen acres to the railroad company. This concession is doubtless due to a want of knowledge of the topography of the island. The claim of the company to any portion thereof is derived from the "Act to grant the right of way to all rail and plank roads," &c., approved August 4, 1852; but this act limits the grant to "one hundred feet in width," except "when deep excavation or heavy embankment is required for the grade," when "a greater width may be taken, if necessary, not exceeding in the whole 200 feet." There is no portion of the tract on Rock Island that has such a "deep excavation or heavy embankment," yet the railroad company has arbitrarily erected its fences so as to inclose an area of variable width, ranging from 100 feet to over 300 feet. The caprice of the company has thus determined the rule in this matter instead of the necessities of the road, as prescribed by the statute. I am unable to state the exact length of the track on the island, but am quite confident that restricting the company to the one hundred feet in width" the area required by the road would hardly reach six acres.

But it is by no means clear, notwithstanding the opinion at chambers of the late Judge McLean, to which the telegram refers, that the law of August 4, 1852, gives any title whatever, and it seems probable that if the question could be brought before a full bench of the Supreme Court for re-examination this decision would be reversed. One section of the statute provides "that none of the foregoing provisions of this act shall apply to or authorize any rights in any lands of the United States other than such as are held for private entry and sale and such as are unsurveyed and not held for public use by erections and improvements thereon. Is is obvious that Judge McLean in his opinion has ignored an essential part of this provision. While indulging in a somewhat irrelevant disquisition on "conjunctions copulative and disjunct-

ive" the real philological point and the rules of grammar applicable thereto seem to have escaped him. A cursory examination of the language will show that the adjective "such" has a much more important claim to consideration than the conjunction "and." The proviso distinctly embodies two independent conditions, each one complete in itself, under which certain lands are exempted from the operation of the act, the first of which is such as are not "held for private entry and sale." No part of Rock Island was then "held for private entry and sale," and therefore none of the provisions of the act granting a "right of way" were applicable to Rock Island. But in order to give a quasi plausibility to the railroad claim, Judge McLean practically expunges the second "such" from the proviso, and thus resolves the two conditions into one.

The railroad is a great public convenience and should not be removed; but whether there is or is not any authority for its construction on these lands of the United States, there is hardly the shadow of a claim for 13 acres now set up by the company, and no such claim should be recognized. Moreover, for the privilege of traversing the island the company should be required to provide a carriage-way for ordinary vehicles on the bridge over the Mississippi River for the free use of the United States, to facilitate the necessary intercourse between the island and the western shore of the river.

If these views meet your concurrence I hope you will take such action as you may think proper to protect the interests of the United States on Rock Island, so far as they are confided to the Ordnance Department.

Very respectfully, your obedient servant,

C. P. KINGSBURY,
Major of Ordnance.

Brig. Gen. GEO. D. RAMSAY,
Chief of Ordnance, Washington, D. C.

CHAPTER III.

GENERAL RODMAN'S COMMAND OF THE ARSENAL FROM 1865 TO 1867.

General Rodman assumes command August, 1865—Condition of the work at this time—Work done under General Rodman's command—Plans for armory and arsenal—Authority to construct temporary shops—Map of the island—Sites selected for buildings—Use of water-power recommended—Transmission of power by compressed air recommended—Removal of railroad recommended—River-wharf—Act of Congress approved April 19, 1864—Lands on the island taken possession of by the United States under aforesaid act—Description of the island and plans for armory and arsenal—Description of buildings—Details of construction—The water-power—Old line of Chicago and Rock Island Railroad—Remains of temporary prison-buildings.

General Rodman arrived at the Rock Island arsenal and assumed command on the 3d of August, 1865. No better evidence could be desired that the Ordnance Department intended to construct a great armory and arsenal at Rock Island than the fact that an officer of such high standing as General Rodman, and one whose services were so valuable to the Department in every way, was selected for the command. He and the Chief of Ordnance had frequent conferences on the subject during the preceding winter and spring. His command lasted from August, 1865, until his death, in June, 1871.

During this time Store-house A (sometimes called the arsenal building) was completed, the water-reservoir was built, two shops and the commanding-officer's quarters were begun and nearly completed, the wagon-bridge to Rock Island was built, and the greater part of the water-power was constructed. A great deal of work was also done in clearing up the undergrowth on the island, laying out and building roads, and protecting the shores of the island from washing by riprap.

But General Rodman's more important works were his plans for the armory and arsenal; his procuring the removal of the Chicago, Rock Island and Pacific Railroad from its position across the island; its re-establishment at the west end of the island, with the construction of

the great bridge connecting the island with the Iowa shore, and the settling of the many claims against the United States growing out of the removal from the island of parties who had established themselves thereon. In all of this work the Chief of Ordnance took an active interest and part.

On the 12th of August, 1865, nine days after his arrival at the arsenal, General Rodman, having made a study of the island and its capabilities, wrote to the Chief of Ordnance as follows:

> You advised me some time since that you wished me to examine and consider Rock Island with reference to the location and erection of such buildings as may be deemed proper to erect thereon, and that after having done so, you wished to confer with me personally in relation thereto. I have examined and considered this subject, and am prepared to discuss it with you, premising that we should have a map of Rock Island for reference, and suggesting that the sooner the questions above referred to are definitely settled the better will it be for the public interest.

In reply to the above letter General Rodman was directed to meet the Chief of Ordnance in New York to discuss plans, and on the 23d of August he went East for that purpose, and was absent until the latter part of October. There is very little correspondence or other matter on record during this time respecting the projected work at Rock Island. What the arsenal should be, its magnitude, capacity, and general plan were determined by General Rodman and General Dyer in their conferences during the time General Rodman was East.

From the time of his return, in October, until the following February, (1866,) General Rodman was busy preparing a map of the island and plans for the arsenal.

On the 20th of January, 1866, he wrote to the Chief of Ordnance for authority to construct cheap temporary shops to be used in constructing the arsenal. This authority was given, and the shops were constructed in the spring and summer of 1866 on the present site of Shop A, and used until the summer of 1873, when they were torn down and removed, and the machinery transferred to Shops C and E, which had been finished and prepared for use.

On the 26th of January the Chief of Ordnance wrote to General Rodman and directed him to report in person at the Ordnance Office as soon as he had completed drawings and was ready to submit plans for workshops, &c. On the 7th of February, 1866, the drawings, a map, and letter of explanation were sent to the Ordnance Office. General Rodman went to Washington on the 10th of the same month, and remained there until some time in April, 1866. During this time the plans for the arsenal were discussed, fixed, and agreed upon between him and the Chief of Ordnance, and also the plans for the removal of the railroad to its new site, and the development and construction of the water-power were decided upon. A bill to carry out the plan of removing the railroad to its new site and to provide for the construction of the bridge was prepared and submitted to Congress. It was passed and approved June 27, 1866.*

There is no correspondence between General Rodman and the Chief of Ordnance on these subjects up to this time, because they were arranged and agreed upon verbally.

General Rodman's letter of February 7, 1866, submitting plans to the Chief of Ordnance, was as follows:

> I send by express this day a plan of Rock Island, showing the proposed plan of arsenal and other improvements thereon.
>
> The site selected for the manufacturing part of the establishment is about the middle

* This act is copied in Chapter V, which gives a history of Rock Island Bridge.

of the island, on high ground, which admits of easy and effective drainage, thus giving dry cellars under all the buildings, where they may be desirable.

The greater part of the timber has already been cut from the proposed site, which is another consideration favoring its selection. It is proposed to commence building in the middle of the length of the proposed site, and enlarge each way as the demands of the country may require, leaving the beautiful park of trees at each end until necessity shall require their removal. It is also proposed to commence building on the south, or arsenal side of the main (east and west) avenue first, making all the buildings suitable for shops, but using such of them as may not be immediately required for that purpose for store-houses, in which to store the property now on the north or armory side of that avenue while the armory buildings are going up, then build store-houses proper to such extent as may be required.

By building on a main avenue as proposed, the establishment admits of extension to any degree likely to be required, whereas by building upon the side of a square, you cannot extend beyond that square, when once completed, without great inconvenience and expense. It is proper that every Government establishment of this character should have the means of running continuously night and day. And with a view to this end, I deem it essential that each shop should be provided with engines and boilers so connected as to insure this object.

Persons of experience in such matters are sanguine that it is practicable to create a water-power at the head of the island of such magnitude that one-half of it would be sufficient to drive all the machinery likely to be required here for some time to come, and, at the same time, secure a healthful flow of water through the minor or slough channel of the river. (See my letter to the Department, dated January 22, 1866.)

Should this be found to be the case, it would doubtless be economy to use it, provided the expense of conveying this power from its place of development to the shops, where it is to be used, shall not be too great.

The points (A and B, see map on Plate I) on the plan herein referred to are the proposed points of development of this power. It is believed that the best and most economical mode of utilizing this power will be, first, to use it for raising water, to be conveyed to the shops and reservoirs in cast-iron pipes, for use of shops, &c., and to guard against fire, the five reservoirs on the high ground being connected by pipes, furnished with attachments for a steam fire-engine, so that all the water in the whole five may be drawn out at one point, if needed. This water is also required to cleanse out vaults, water-closets, &c., all of such sewerage being carried into the main sewer, and then to the slough. Second, use the remaining power at the points of its origin for condensing air, to be conveyed in cast-iron pipes to the shops, then to be passed in tubes through the steam-drum of the boiler, and worked through the steam-cylinder the same as steam; so that, when there is sufficient water-power, no steam-power will be used, and when the water-power is out of order, steam may be used, in whole or in part, as may be required, having valves, so that the air may be shut off from any or all of the engines at will. This will give a supply of air under pressure for blowing forge and foundery fires, and for running heavy drop or vertical hammers, where steam would be objectionable on account of its condensation into water in the intervals of actual use.

By escaping air, when used in place of steam, into the shops they would be warmed and ventilated in winter, the temperature of the air being under complete control, by passing through the steam-drum, and ventilated in summer by an atmosphere cooler than the exterior air, since heat would be developed by its compression at the source of power, and that heat would be given out on its way under ground to the shops, where, on again expanding, it would, as stated, have a temperature below that of the exterior air.

The magazines and laboratories are situated at what is believed to be a safe distance from other buildings, the intervening space being covered with trees and shrubs. The site proposed for the magazine is on higher and, therefore, better ground than that heretofore selected.

An internal system of railways would connect all parts of the establishment when any large quantity of material will have to be transported, and this system of roads should connect with the Chicago and Rock Island Road, which crosses the island. The present location of this road upon the island is not a suitable one. It cuts the island into two very inconvenient parts, admitting of access from one part to the other only by passing under it on one side of the island and over it on the other, where the wagon-road now crosses, and being too high to switch from conveniently at any point except at this crossing. It is, therefore, proposed and recommended that this road be removed to the lower extremity of the island, where the grade is high enough to admit of switching from it at any point. But to do this would require the removal of the railroad-bridge from its present position to that shown in the inclosed plan. It is proposed to remove the railroad-bridge accordingly, and let the piers be made long enough up and down stream to admit a double-track, and also to receive a wagon-road bridge, the road to which would run from Rock Island City along the present bridge and embank-

ment, widened to 60 feet, and along the edge of the bluff the same width; it would also be accessible from the island, as shown.

It is also proposed, in this connection, to prepare a proper wharf or steamboat-landing just above the proposed site of the new bridge, so that stores, received or issued, whether by rail or river, would be convenient to the present arsenal building, which I would use as a receiving and issuing and distributing store-house. The advantages of this arrangement would be—

1st. To the Government, in getting rid of the present embankment and road across the island, and in having it located where it would be accessible and valuable for receiving and shipping stores, and where a single fence would secure the island from intrusion by persons passing upon the road. The proposed location would also diminish the chances of fire from locomotives. The wagon-road to Rock Island City would pass under the railroad, instead of on a level with it, as at present, and the bridge to Davenport would give access to that city from the island, and thus enable the Government to draw supplies and labor from that source, as well as from Moline and Rock Island City.

2d. To navigation, in diminishing the obstruction, hinderances, and dangers offered to that interest by the present bridge, it being in rapid water and at a comparatively narrow point in the river, while the proposed bridge would be at a wider point of the river, in deeper and comparatively still water, where the least hinderance possible would be offered.

The plans set forth in this letter can be understood more readily by reference to the map on Plate I.

This map is copied mainly from the map that General Rodman sent to the Chief of Ordnance with the foregoing letter. But some plans, or ideas for plans, which were shown on the map and are known to have been abandoned by General Rodman subsequently, have been omitted, and, as far as practicable, all subsequent plans made by General Rodman have been compiled and added to it.

For convenience in description, the sites of the confederate prison-buildings are also shown on the map, and also the boundaries of lands, owned or occupied by outside parties on the island, that were taken possession of by the Secretary of War, under authority of the act of Congress of April 19, 1864.

DESCRIPTION OF THE ISLAND OF ROCK ISLAND, THE SHOPS, AND SOME OF THE PLANS INDICATED IN THE FOREGOING LETTER, AND SHOWN ON THE MAP, ON PLATE I.

The island is about 2¾ miles long, and varies in width from one-fourth to three-fourths of a mile, and contains above low-water mark 970 acres. Lengthwise the island lies nearly east and west, and the course of the Mississippi by the island is generally about 11° south of west. From the east end to East avenue, about 1½ miles, it is covered generally with sparse timber. On much of this part the first growth of timber has been removed and is replaced with a second growth, mixed with some large old trees that remain. Nearly all this part, except about 40 acres lying east of the Confederate cemetery, has had the undergrowth removed and is now open groves and spaces, bare of trees, covered with blue-grass. I have indicated some low grounds on the map. These were probably at one time covered with water, and formed channels of the river between the higher parts of the island. They are now covered with heavy timber and undergrowth, and, in places, are subject to overflow during very high water. The largest of these is the tract lying west of East avenue and south of South avenue and the prolongation of its line to the west end of the island. There is a high ridge running part of the way through this tract, on which are shown sites for magazines and laboratories. There is no timber on all the part occupied by the "Davenport place" and on all the part west of the old line of the Chicago, Rock Island and Pacific Road. These grounds were cleared of

timber many years ago, and no second growth has taken its place. The native trees on the island are principally oak, elm, ash, bass-wood, hickory, and walnut. The highest ground on the island, as stated in General Rodman's letter, is the part where the shops are located on the map, and also extending about 500 yards west of West avenue along the line of Main avenue nearly to the east end of the island. All of this part is from 17 to 23 feet above the highest high water, and the rest of the high grounds are generally from 14 to 20 feet above high water. All of the high grounds are on a foundation of gray magnesian limestone, which in places crops out on the surface, but is generally covered with from 1 to 8 feet of earth, principally loam and clay, and sometimes sand, gravel, and many other earths deposited by the water after its subsidence into the present valley of the Mississippi.

The limestone is hard, strong, and durable, and answers well for building roads and for foundations and concrete, but is much broken up and washed; is seamy and mixed with earth; has been acted on by frost, and is never found in beds fit for quarrying for building purposes.

After deposition it appears to have been broken up and shattered and then washed and worn, and the pockets and crevices are generally filled with clay. Some of these pockets are very large. In one case, near the center of the island, I excavated one to the depth of 40 feet in seeking foundations, and below the level of the water in the river found an open cave, a deposit of white sand and running water, showing evidently that the water percolated through crevices in the rock from the river toward the upper part of the rapids, and found its way to the river again at a lower level. A full account of this excavation, (for Shop D, in 1871,) and much other interesting matter respecting the formation of the island, will be found in its proper place in describing the progress of the work of construction at the arsenal. The rock furnishes perfect foundations when care is taken to secure good rock to build on, but great care and thorough exploration and examination are required. This sometimes involves deep excavation, much blasting, shoring, and is difficult, expensive, and takes time. As the difficulties that will be experienced in procuring foundations cannot be foretold, no certain estimate of the cost of foundations can be made before the work is begun.

The city of Davenport, in Iowa, with its center about opposite the west end of the island, has a population at the present time of about 25,000.

The city of Rock Island, in Illinois, with its center about opposite the west end, has a population of about 14,000, and the city of Moline, in Illinois, opposite the east end, has a population of about 6,000. All of these cities are engaged largely in manufactures, a matter of much importance to the interests of the arsenal, and all are rapidly increasing in business and population.

This description of the island is longer than was intended, but it is believed that it will be useful and necessary to a good understanding of what follows.

The plans for armory and arsenal shops, as indicated in General Rodman's letter of February 7, 1866, are shown in the map on Plate I. The row of five shops south of Main avenue are for the arsenal, and the five north of the same avenue are for the armory. The center shop (Shop E) in the arsenal row is the forging-shop and foundery for the arsenal, and the other four are finishing wood, metal, and leather working shops of all kinds for the manufacture of all the material of war manufactured at the arsenals of the United States.

The center shop (F) of the armory row is the rolling-mill and forging-

shop for the armory, and the other four are finishing and wood-working or "stocking" shops for the manufacture of all kinds of small-arms. The center shop in each row is only one story high, and the other four in each row have a basement and three other stories. The ground-plans of the whole ten shops are exactly alike. The ground-plan shown on the map is copied from the map sent to the Chief of Ordnance, February 7, 1866. This plan was subsequently changed before any shop was begun, and the plans of the shops which have been built are as shown in Figure 1 on the same map. The change consists only in throwing out two porticoes in front and two on each side of the building. Its object was, partly, to add strength to the walls of the buildings, but principally to add beauty to the architecture, and in this it has been very successful. It was the subject of a good deal of discussion between General Rodman and General Dyer, the Chief of Ordnance, but the discussion was a verbal one, and there is nothing on record to show when the change was made. There is also shown on the ground-plans of the shops a building crossing the court and connecting the two wings. This was intended for a boiler-house and steam-engine room. I cannot find that any perfected plans for this building were ever made, and it was subsequently abandoned. It is certainly better to leave the court clear for teaming purposes, as it gives access to doors in all parts of the building, and to build a boiler-house in the court entirely separate from the shop, and to place the engines on the first floors of the shops. This arrangement is shown for Shop C, on Plate IV. This boiler-house was built in 1872 and 1873.

The dimensions of the ground-plan are given in the drawing. Each building consists of two parallel wings, 60 feet by 300 feet, 90 feet apart, and connected at the front by a building 60 feet by 90 feet. This leaves an interior court 90 feet by 238 feet. The porticoes at the sides project 12 feet and are 60 feet wide, and those in front project 2 feet and are also 60 feet wide. The total area of each shop, including thickness of walls, is 44,280 square feet, a little more than one acre.

Plates VII and VIII give front and side elevations of the center or forging shops, (E and F,) and also cross-sections through the walls; and Plates II and III give the same elevations and cross-sections for the other eight shops.

Plate IV gives a plan of one of the latter shops, showing arrangement of iron floor-beams, columns, elevators, hatchways, stairways, and basement piers. The iron floor-beam stringers consist of two wrought-iron |-beams bolted together. The wrought-iron |-beam joists rest on the flange of the stringer-beam and on offsets in the main walls of the building. They are also bolted to the stringers with wrought-iron angle-pieces.

For the first and second floors the stringers are made of two heavy 15-inch beams, each 200 pounds per yard, and the joists are light 12¼-inch beams, 125 pounds per yard. For the third floor the stringers are made of two heavy 12¼-inch beams, each 170 pounds per yard, and the joists are heavy 9-inch beams, 85 pounds per yard.

The stringers of the first floor rest on stone-masonry piers (in the basement) 2¾ feet square and placed at intervals of about 20 feet. For the other two stories the stringers are supported by iron columns. The position of the stringers is shown in the drawing. The spaces between the joists are about 5 feet, generally a little less than 5 feet, and these spaces are filled with the brick fire-proof arches. Crossing the joists, or matched in between, above the brick arches, are wooden joists 2½ inches by 5 inches, and on them are laid dressed and matched 1½-inch

oak floors, except on the third floor, which is of pine. The first and second floors will carry 200 pounds per square foot, and the third floor 100 pounds per square foot. The locations of the elevators and hatchways are sufficiently shown on the drawing. The hatchways will probably not be required except for taking in or removing machinery, and at other times will be covered and used as shop-floor. The stairways are all of iron, except the hand-rails.

The roof-frame is entirely of wrought iron. The trusses span the whole distance from wall to wall, so that the third story is free from columns. The trusses are at intervals of 10 feet, and have sufficient strength to carry the slate roof, and an added weight from snow or pressure of wind of 20 pounds per square foot normal to the surface.

On the main rafters of the trusses the 4-inch I-beam purlins are fastened 4½ feet apart; wooden rafters are matched in between these, and 1¼ inch pine sheathing, matched and planed, is nailed on the wooden rafters. The slate is laid on the wooden sheathing. All the peak-covers, flashings, valleys, gutters, and down-spouts are of 2½-pound sheet copper.

The walls are entirely of stone, and their thickness as shown in the cross-sections on Plates II and VII. The exterior or face-stones are heavy ashler, laid in courses, jointed, and having a squarely-broken face without tool-marks. The thickness of courses is made to suit the product of quarries, and ranges generally from 12 inches to 26 inches. The backing is rubble, laid also in courses, and has its face, which forms the interior of the wall, well pointed. Two courses of rubble are made to equal one course of ashler in height, and, to give sufficient bond, about one-sixth of the face-stones, including dimension-stones, run entirely through the wall. The only dimension-stone used is that required for the water-table, caps and sills, entablature, and arch-stones. The faces of all these are chiseled and bush-hammered work. The interior face of the wall is well pitch-faced work, and it is not plastered. A consideration of the foregoing will show that, with proper care and ability, excellent and handsome walls can be obtained, while the variety of stone used, only a small part of it being dimension-stone, will enable the quarryman to use and furnish all the good stone his quarry produces, whereby the highest economy in construction is obtained.

The foregoing details of construction were not arranged when General Rodman first sent his plans to the Chief of Ordnance. They are the result of much subsequent careful study, and have been changed or improved, from time to time, to secure greater perfection and economy. It is deemed best, however, for convenience, to give a full description of the shops here, and to notice hereafter in their proper place such changes in construction as may be interesting.

The map on Plate I shows the plan first proposed for the development of the water-power and location of the pipe to be laid from the water-power to the shops to convey power by means of compressed air. This plan for the development of the water-power was subsequently abandoned by General Rodman, and another plan, as indicated on the map, was adopted. A full description of the power and history of its development and construction is given in another place.

The old line of the Chicago, Rock Island and Pacific Railroad across the island and the new route selected are also shown on the map, and a full history of the construction of the new route and the bridges will be given in its proper place.

The temporary prison-buildings shown on the map have nearly all been removed, from time to time, as they have decayed, become worthless,

and the necessity for their use has passed away, or they have interfered with the construction of the arsenal buildings.

At the present time (1876) only the temporary stables, a few officers' quarters, and one of the hospital-buildings, now used as a post-hospital, remain.

CHAPTER IV.

BOARD OF COMMISSIONERS.

Appointment of the board of commissioners by the President—The commission to meet at Rock Island on October 1, 1866—Notification sent to parties interested—The claim of the city of Rock Island—The claim of David B. Sears—The Davenport claim—The claim of Stephens, Huntoon & Wood—The claim of Nels Johnson—The claim of David Sears—The claim of Robert Welch—Claims of James Robinson, Daniel Jones, and Peter Peterson—The claim of the town of Moline—Meeting of the commissioners—Examination of witnesses as to the value of the property taken possession of by the United States—Analysis of testimony in appraising the property of David B. Sears before the commissioners—Appraisement of the Davenport place—Appraisement of property belonging to Stephens, Huntoon & Wood and minor claimants—Claim of the town of Moline—Claim of the Chicago, Rock Island and Pacific Railroad Company—The commission adjourns and makes its report to the Chief of Ordnance—Decree of the district court—Summary of awards.

The board of commissioners to adjust claims against the United States of parties whose property had been taken possession of under the act of April 19, 1864, (see Chapter II,) and under the act of June 27, 1866, (see Chapter V,) was appointed by the President of the United States in the summer of 1866, and consisted of the following members:

Maj. Gen. J. M. Schofield, United States Army.

Hon. James Barnes, of Springfield, Mass.

Hon. Seldon M. Church, of Rockford, Ill.

On the 25th of September, 1866, the Chief of Ordnance notified General Rodman that the commission would meet at Rock Island about October 1, 1866, and directed him to notify all parties interested, that they might be prepared to submit their claims and substantiate the same by evidence.

The following-named parties were notified accordingly:

The city council of Rock Island.

Mr. David B. Sears, of Moline.

Messrs. George L. & B. Davenport, of Rock Island.

Mr. B. Davenport, of Rock Island.

Messrs. Stephens, Huntoon & Wood, of Moline.

Mr. James Robinson, of Moline.

Mr. Peter Peterson, of Moline.

Mr. Robert Welch, of Moline.

Mr. Daniel Jones, of Moline.

Mr. David Sears, of Moline.

Messrs. Dimock & Gould, of Moline.

Mr. S. H. White, of Moline.

Messrs. Sears & Sons, of Moline.

Mr. Edward R. Healy, of Moline.

The president of the Chicago and Rock Island Railroad and the Moline Water-Power Company of Moline.

Several of these parties had prepared their claims and abstracts to prove title prior to this, and the same had been transmitted to the Chief of Ordnance, and were subsequently laid before the commission. (For location of various claims see map on Plate V.)

The claims of the various parties were as follows:

CITY OF ROCK ISLAND.

The city of Rock Island presented a claim for payment for a bridge and causeway from the city of Rock Island to the island, and for Wilson's Island, on which a portion of the causeway had been built. The bridge was built by the city of Rock Island, (E. T. Reynolds, contractor,) in September, 1863. It was taken possession of by the United States, under the act of April 19, 1864, in September, 1866. It was a cheap, wooden structure, located exactly on the site of the present Government bridge from the island to the city of Rock Island, but was about 200 feet shorter than the present bridge, the causeway from the island shore being much longer than it is now.

One span of the bridge broke down in the winter of 1867, and was repaired by the United States.

In the spring of 1868 the bridge was carried away by the ice, and was never replaced. The commanding officer of the arsenal substituted a rope ferry, which was used until the new iron bridge was ready for use.

Wilson's Island is not generally known at the present time, but it is the sand-bar lying below the causeway and the foot of the island of Rock Island. It is covered with water the greater part of the year.

In the fall of 1865 the city of Rock Island furnished abstracts of titles, and made an offer to the commanding officer of the arsenal to sell the bridge and causeway to the Government for $17,000.

In January, 1866, the commanding officer of the arsenal wrote to the mayor of Rock Island, inquiring whether the offer included Wilson's Island, and was informed in reply (January 13) that it only included so much of Wilson's Island as was occupied by the bridge causeway, but that the city would sell the remainder of the island for the further sum of $700. With this letter abstracts of title to Wilson's Island were inclosed.

The foregoing papers were transmitted to the Chief of Ordnance, January 19, 1866, and were subsequently laid before the board of commissioners.

The claim of the city of Rock Island presented to the board of commissioners was as follows:

This claimant, the city of Rock Island, a corporation created by and doing business under the laws of the State of Illinois, and having its principal place of business within the county of Rock Island and State of Illinois, and within the northern district of the State of Illinois, respectfully represents and shows unto your honorable commission:

That this claimant is the owner, in fee-simple absolute, of a certain island in the Mississippi River known as "Wilson's Island," contiguous to the island of Rock Island, and mentioned in the said act above referred to, approved June 27, 1866; and is also the owner of and justly entitled to all and every the hereditaments and appurtenances thereto belonging or in any wise appertaining, and the reversion and reversions, remainder and remainders, rents, issues, and profits thereof; and more especially mentioning a part thereof, of the embankment and roadway, made and being thereon, and the wagon-bridge across the east branch of the Mississippi River, connected therewith and abutting thereon and connecting the said "Wilson's Island," as also the island of Rock Island, with the east shore of the Mississippi River, at a point within the corporate limits of the said city of Rock Island.

This claimant further represents and shows unto your honorable commission that the said island known as "Wilson's Island," and the said bridge, and the landing thereof on the east shore of the Mississippi River, and, as well, the landing thereof on the island of Rock Island, lies and is situated within the corporate limits of the said city of Rock Island, and in sections thirty-five and thirty-six, in township numbered eighteen (18) north, of range two (2) west, of the fourth principal meridian, in the State of Illinois; and that the said island known as "Wilson's Island" contains, according to the survey made by the United States Government, seven acres and sixty-one hundredths of an acre, ($7\frac{61}{100}$.) And for a more particular description of the location of the said "Wilson's Island," and the bridge connected therewith in reference to

the island of Rock Island, and the corporate limits of the said city of Rock Island, and the section lines above referred to, as well as the approaches to the said bridge, your honorable commission is respectfully referred to the plat or map accompanying this statement.

This claimant further represents and shows unto your honorable commission that at the time the said island called "Wilson's Island" was purchased by this claimant, and at the time said embankment, roadway, and bridge were built and constructed, as hereinafter stated, a considerable portion of the island of Rock Island was owned by private individuals, and a considerable number of the citizens and inhabitants of the said city of Rock Island were residing upon the said island of Rock Island; that all of that portion of said island of Rock Island lying and being in township eighteen (18) north, of range two (2) west, of the fourth principal meridian, in the State of Illinois, was and now is within the corporate limits of the said city of Rock Island; and that there was considerable business of a private and individual nature being transacted between the said inhabitants of the said island of Rock Island and the inhabitants of the main shore in the said city of Rock Island, and that it was the duty of the corporate authorities of the said city of Rock Island to provide and furnish reasonable facilities for communication with the said island of Rock Island and the inhabitants thereon; and in pursuance of the said duty the said embankment, roadway, and bridge were constructed, and the said island known as "Wilson's Island" and the approach on the easternmost shore of the Mississippi River to said bridge were purchased.

This claimant further shows unto your honorable commission that very soon after the completion of the said bridge, embankment, and roadway, the United States Government took possession and control of the said bridge, embankment, and roadway, and have in fact ever since that time really held and controlled the same, and has used, and still continues to use, the same for its own purposes exclusively; but this claimant was never officially notified of the taking possession of the said island known as "Wilson's Island" until about the 27th day of August, A. D. 1866.

This claimant further shows unto your honorable commission that the said embankment and roadway across and upon said "Wilson's Island" is a material and necessary part and portion of the said bridge, and that said bridge would be utterly useless and of no value except as connected therewith, and that the said bridge and the approach thereto, on the easternmost end thereof, is appurtenant to the said island and of no value if disconnected therefrom.

This claimant further shows unto your honorable commission that the said bridge, embankment, and roadway, and the said island known as "Wilson's Island" and the immediate approach to the easternmost end of the said bridge, was purchased and erected by this claimant in the months of September and October, A. D. 1863, and at a cost to this claimant of fourteen thousand three hundred and fifty-seven dollars and twenty cents, and that this claimant has paid out, and is liable for interest on money borrowed to make said purchases and build said bridge, in the further sum of four thousand two hundred and forty-three dollars and seventy-seven cents, as will more fully appear by reference to the schedule of the cost of said bridge, &c., hereto attached, and that this claimant has, by reason of the possession of said bridge, embankment, and roadway, being really in the possession of the Government of the United States, as aforesaid, never derived any revenue by way of tolls therefrom; and that the said island known as "Wilson's Island," and the said embankment, roadway, and bridge, and approaches owned by this claimant, are reasonably worth the sum of twenty thousand dollars.

And this claimant offers that upon the payment of the said sum of twenty thousand dollars to this claimant, it will, by deed, duly executed according to law, transfer the title to the said "Wilson's Island" and to the said bridge and approaches as your honorable commission may direct.

And the several allegations of this statement said claimant is ready to maintain and prove, as to your honorable commission may seem meet and best, and herewith produces an abstract of the title of the said city of Rock Island to said property and certified copies of the muniments of title thereto, to which your honorable commission are respectfully referred.

Whereupon this claimant prays that your honorable commission award to this claimant the said sum of twenty thousand dollars, and, as well, its reasonable cost incurred in sustaining this its complaint.

October 8, 1866.

(Signed) C. TRUESDALE,
Mayor.

(Signed) CHARLES M. OSBORN,
City Attorney.

SCHEDULE.

Schedule of the actual cost of the island known as "Wilson's Island," and the bridge, embankment, and roadway connected therewith, showing dates of payments and items.

1863.			
Sept.	7.	To cash paid E. P. Reynolds, contractor	$6,000 00
Oct.	27.	do. do. do.	4,000 00
Nov.	2.	do. do. do.	1,000 00
Nov.	9.	To cash, stone filling	106 75
Nov.	9.	To cash paid for "Wilson's Island"	200 00
Nov.	21.	To cash paid for stone for bridge	300 00
Nov.	21.	To cash paid for post for bridge	15 00
Dec.	7.	To cash paid E. P. Reynolds, contractor	2,400 00
Dec.	21.	To cash paid sundries for bridge	20 00
1864.			
Jan.	5.	To cash paid P. Simon for hauling	6 00
1865.			
Dec.	19.	To cash paid C. H. Case, sand for embankment and southern approach to bridge	200 00
1866.			
Jan.	2.	To cash paid C. H. Stoddard, surveying bridge	16 50
Feb.	2.	To cash paid sundries, J. H. Johnston	9 45
March	7.	To cash paid Charles M. Osborn, abstract of "Wilson's Island" and approaches to bridge, and perfecting title	83 50
			14,357 20
1866.			
Oct.	8.	To interest on above items at 10 per cent. to date	4,243 77
			18,600 97

STATE OF ILLINOIS,
Rock Island County:

Calvin Truesdale, being first duly sworn, upon oath states that he is now mayor of the city of Rock Island, in said county; that he has examined the records and account-books of said city with reference to the cost to it of the island of Wilson's Island, the embankment and bridge upon and across the same, and the approach to the said bridge from the main shore of the Mississippi River, and that the foregoing schedule is a true and correct statement of such cost, as appears from said records and accounts

C. TRUESDALE.

Subscribed and sworn to before me this 10th day of October, A. D. 1866.

EDWARD D. SWEENY,
Police Magistrate.

THE CLAIM OF DAVID B. SEARS.

Mr. David B. Sears was the owner of Benham's Island, of a flouring-mill, dwelling-house, with barn and outbuildings, and three warehouses located thereon; also a steamboat-landing. This island is situated near the upper or eastern end of the island of Rock Island, and is connected therewith by a substantial stone wall 442 feet long and 30 feet wide, which is used as a roadway. Near this locality Mr. Sears owned originally the southeast fractional one-fourth and east one-half of southwest one-fourth of section 29, and the northeast fractional one-fourth of section 32, township 18 north, of range 1 west, comprising 35.45 acres. (See map on Plate V.)

This land was entered by him under special act of Congress of January 24, 1855, and a patent for the same issued from the General Land-Office on the 1st of November, 1855. The title to Benham's Island was acquired by Mr. Sears on September 20, 1854, by purchase, and comprised originally an area of 1.11 acres. The mill on this island was built during the year 1859 or 1860.

By the building of wing-dams at the head and foot of the island and excavation below the stone dam, a valuable water-power had been developed, which furnished motive-power to Mr. Sears's mill on

Benham's Island, and also to several other establishments on the opposite shore on Rock Island.

The pond created by the formation of the upper wing-dam and the stone dam was at its mouth about 800 feet wide, with an average depth of 4½ feet to 5 feet, and furnished an excellent harbor for logs.

Mr. Sears's property on Rock Island had been surveyed, platted, and lotted under the name of "Island City," and a number of lots had been sold to other parties by Mr. Sears, some of whom had erected improvements thereon. The lots adjoining the river were the most valuable by reason of their proximity to the water-power.

The owners of the different lots prepared each separately their titles and claims for re-imbursement of the property taken by the Government under the act of Congress approved April 19, 1864.

Mr. Sears's petition to the board of commissioners was as follows:

To the honorable the board of commissioners appointed under the act of Congress entitled "An act in addition to an act for the establishment of certain arsenals," approved April 19, 1864.

The petition and claim of David B. Sears, of the county of Rock Island, and State of Illinois, respectfully show that he is the owner in fee, in severalty, of the following-described tracts of land, with the appurtenances thereunto respectively belonging, situated on Rock Island, in said county, in one body, and laid out as "Island City subdivision No. 1 of the town of Moline," and the plat thereof duly filed for record in the office of the recorder of deeds of said county May 11, 1858, by said David B. Sears and one George L. Nickolls, to wit:

1. The S.W. fr'l ¼ of the S.E. fr'l ¼, sec. 29, T. 18 N., R. 1 W., $4\frac{8}{100}$ acres.
2. The E. fr'l ½ of the S.W. fr'l ¼, sec. 29, T. 18 N., R. 1 W., $28\frac{10}{100}$ acres.
3. The N.W. fr'l ¼ of the N.E. fr'l ¼, sec. 32, T. 18 N., R. 1 W., $3\frac{85}{100}$ acres, and making together $35\frac{45}{100}$ acres *excepting* the following-described town-lots in said subdivision No. 1, according to said recorded plat thereof, a certified copy of which plat is hereunto annexed, to wit:

Lot No.	8 in	Block No.	9
Lots "	11, 12, 13, 16, 17, 18, 19, and 20 in	" "	10
Lot "	4 in	" "	11
Lots "	4, 5, and 6 in	" "	12
Lots "	1 and 2 in	" "	13
Lot "	5 in	" "	15

Making in all excepted sixteen lots.

This claimant further shows that he is also the owner in fee, in severalty, of the small island in the Mississippi River near the head of Rock Island, and in said section 29, known as Benham's Island, containing $1\frac{1}{100}$ acres, more or less, with all and singular the appurtenances thereof, including the dam from said island to Rock Island and the water-power thereby created.

That his title to said several tracts is derived directly from the United States, he having entered the three fractional parcels first above mentioned, and laid out as aforesaid, at the land-office in Dixon, Illinois, on the 28th of February, 1855, under the special act of Congress approved January 24, 1855, as per duplicate No. 37897, and Benham's Island at the same office, as per duplicate No. 24896, and is perfect and wholly free from incumbrance, excepting only the sixteen town-lots above excepted; and this claimant further shows that the said several tracts, with their appurtenances, are reasonably worth, in all, the sum of one hundred and sixty thousand dollars, ($160,000,) which he distributes and estimates and claims therefor as follows, viz:

For the lots in said Island City subdivision No. 1 to the town of Moline, still remaining in him, with their respective appurtenances, the sum of.....	$10,000
To one-half of the dam between Benham's Island and Rock Island (including one-half of the two wing-dams respectively above and below Benham's Island) and of all the water-power thereby created, the further sum of....	50,000
And for Benham's Island, with structures thereon and appurtenances, and the residue of said dams and water-power, the further sum of.....	100,000

This claimant further shows that the United States, through the War Department, has taken exclusive possession of all and singular the said property of this claimant above described, and now holds the same for the purposes in that behalf set forth in said act of Congress of April 19, 1864.

That possession was so taken of that portion of the said property on Rock Island, and the water-power thereon created by said dams, on the first day of November, A. D. 1864, and of the residue of said property on the 1st day of September, A. D. 1866, and

this claimant respectfully claims interest on the values thereof respectively, as above set forth, at the rate of 6 per centum per annum from the time of possession so taken, as well as the said values so set forth, and prays your honorable commission to award the same to him upon proof of the matters and things aforesaid, which he is ready to submit and make as he may be by you directed, and upon his releasing and conveying the property aforesaid by proper deeds to the said United States.

All of which is respectfully submitted.

D. B. SEARS.

THE DAVENPORT CLAIM.

The "Davenport place," on Rock Island, was entered on August 31, 1844, by George Davenport, as the southeast fractional quarter of section 25, township 18 north, of range 2 west of the fourth principal meridian, and comprised, in all, 157.81 acres. (See map on Plate V.) The entry to this land was allowed by special act of Congress of April 2, 1844, and a patent for the land was issued from the General Land-Office on September 1, 1845.

The land, on account of its substantial improvements and its proximity to the cities of Rock Island and Davenport, was valuable; and its value became enhanced by reason of its proximity to the proposed arsenal-buildings.

Mr. George L. Davenport submitted his claim to the Secretary of War, as follows:

DAVENPORT, IOWA, *June 21st*, 1865.

DEAR SIR: By the terms of a law passed and approved April 19, 1864, I find you are authorized to settle with the owners for lands taken for the erection of an arsenal on the island of Rock Island, Ills. Under this law the S. E. frac. ¼ section 25, T. 18 N., R. 2 W. 4th P. M., 157$\frac{8}{100}$ acres, belonging to me, (subject to my mother's life-estate therein,) was recently taken possession of by the United States. I now claim compensation therefor at the rate of $500 per acre. This makes my entire claim $78,000. If this meets with your approval, I will, on receipt of the amount, execute (with my mother) all necessary releases and conveyances.

It may not be improper to state now, in support of this claim, that this tract is very beautifully and favorably located for either residences or business purposes, and that the lands contiguous on either shore are worth from $700 to $1,000 per acre.

An examination of the public surveys recently made by the officer in charge here will show that this tract is by far the most valuable of any portion of the island. It lies adjacent to the cities of Rock Island, Illinois, and Davenport, Iowa, and in the heart of a rich agricultural region, with both water and railroad communication to excellent markets, and situated, too, at the foot of the Lower Rapids, which have sufficient fall to give a good water-power. This tract, for manufacturing purposes, is very valuable.

But as the public surveys contain all the particulars concerning the location and surroundings of Rock Island, I will at this time only trouble you with this brief mention of them.

I desire to add, however, that there are on this tract excellent stone-quarries which are here exceedingly valuable, that there is (or *was* when taken by the United States) about $10,000 worth of timber on said lands, and that the improvements thereon cost upward of $20,000.

It will thus be seen that the amount at which I have fixed my claim is but the fair and reasonable valuation of these lands, and I trust it will meet with your approval.

I respectfully request that you will give this matter early attention, and that, as soon as possible, I may be advised of your decision.

I am, sir, very respectfully, your obedient servant,

GEO. L. DAVENPORT.

Hon. EDWIN M. STANTON,
Secretary of War, Washington, D. C.

THE CLAIM OF STEHPENS, HUNTOON & WOOD.

The claim of Stephens, Huntoon & Wood was for lots 1 and 2, block 13, and lots 4, 5, and 6, block 12, in Island City, on which the parties had erected a saw and planing mill, paint-shop, dwelling, &c. They

also owned the lease of all the water that would issue from a 100-foot opening at the Rock Island end of the stone dam connecting Rock Island with Benham's Island. Their title of real estate and also the leasehold of the water-power had been obtained from D. B. Sears by purchase. Their petition for re-imbursement of the property taken by the Government is as follows:

MOLINE, ROCK ISLAND COUNTY, ILLS.,
January 18*th*, 1865.

GENERAL: We beg leave to represent to you that in June last we were notified in writing by Maj. C. P. Kingsbury, of the Ordnance Department of the United States Army, to vacate in behalf of the United States the premises occupied by us on the island of Rock Island, in this State, on or before the first day of November, A. D. 1864, in conformity to instructions from the Chief of Ordnance, U. S. Army, at Washington, D. C., by virtue of and pursuant to an act of Congress, approved April 19th, 1864.

And now, in compliance with the request of Maj. Kingsbury, we herewith submit for your inspection a certified abstract of title to the lands owned and occupied by us on said island, to wit: Lots Nos. four, (4,) five, (5,) and six, (6,) in block No. twelve, (12,) and lots Nos. one (1) and two, (2,) in block No. thirteen, (13,) all in that part of the town of Moline known as "Island City subdivision No. one, (1,)" situated on the left bank of the Mississippi River, near the head of said island, which said abstract is hereto attached and marked "Exhibit A."

Our improvements thereon consist of a mill, 45 by 95 feet, and three stories in height from the water.

We use the second (2) story for manufacturing lumber, in which we have one (1) muley up-and-down saw, a rotary saw, two cutting-off saws, and a machine for the manufacture of lath; also cars and tracks for conveying the lumber from the mill.

The machinery in the mill is driven by four (4) iron water-wheels, even seven (7) feet in diameter, and each issuing 700 inches of water. These wheels are so coupled together by gearing that we get a good power under a very low head of water.

There is also a single seven (7) foot wheel issuing 700 inches of water, which is used for hauling the logs into the mill from the boom, running planer, sawing shingles, &c. These wheels are all in good condition, three of them having been put in new in 1863. All of the aforementioned machinery is in good running order. The mill is of sufficient capacity to manufacture 3,000,000 feet of lumber per annum. Attached to this mill is a room, 25 by 60 feet, in which we run one shingle-machine and one chair-machine. There is also a planing-house, 40 by 40 feet, one and a half (1½) stories in height. In this house we have one Woodworth flooring-machine, one face-planing machine, and one machine for making siding. The third story of the mill we use in which to manufacture chairs, bedsteads, and all other kinds of household furniture. This room is 45 by 95 feet, and is well stocked with tools and machines of the most modern and improved patterns.

The machinery in the third story is driven by a separate water-wheel of the same dimensions and issuing the same amount of water as the wheels above mentioned. We employ in the room on an average twenty (20) men. There is also a finishing-house, 25 by 40 feet, two (2) stories high; also an ice-house and a business office. The flume through which the water is conducted to the mill is 32 by 95 feet, being formed by two parallel permanent stone walls, eighteen (18) feet high. This flume is spanned by a timber bridge which forms part of the roadway leading from the island of Rock Island to Benham's island. All of this work was new in 1863. We would further represent that the mill is in good condition, except the basement story, which needs some repairs.

The water-power, by which the machinery is driven, we do not own, but rent of David B. Sears, for the time and on the terms and conditions contained in a written lease, a copy of which is hereto attached and marked "Exhibit B."

We would further represent that we have a large stock of logs, to wit, about 2,700,000 feet, on the Black and St. Croix Rivers, in the State of Wisconsin, which we purchased (prior to the act of Congress approved April 19, 1864) to stock our said mill, but which we have not been able to get, owing to the unprecedented low stage of water in the Mississippi River. (Lower than it has been known to be at any time in the last twenty-five (25) years.) We would further represent that we may reasonably expect that the stage of water will be such next spring as to enable us to bring said logs to our mill. Should we be obliged to vacate and surrender the said premises to the United States before we can receive and work up said stock of logs, we must suffer great pecuniary damages thereby. We trust, therefore, that the United States will permit us to remain in the possession and use of the same, upon our paying such rent therefor as shall seem to the United States just, until they are actually wanted for Government purposes. We would further state that we have paid to the United States in taxes, in the year just past, on the products of said mill, an amount equal to

eight (8) per cent. upon the valuation which we hereinafter place upon the said property. We value the premises and improvements at ($18,000) eighteen thousand dollars, and we would most respectfully request that the United States will at an early day have our claim examined and adjusted.

We have the honor to be, very respectfully, your ob't serv'ts,

STEPHENS, HUNTOON AND WOOD.

Brig. Gen'l A. B. DYER,
Chief of Ordnance, U. S. Army.

THE CLAIM OF NELS JOHNSON

was for lot 5, block 15, in Island City, improved by a small frame house and outbuildings, shrubbery, and fruit trees; title to the land having been conveyed to him by purchase from D. B. Sears. Mr. Johnson's application for compensation was as follows:

MOLINE, ILLS., *January 18th*, 1864.

GENERAL: I beg leave to represent to you that I was, in June last, notified by Maj. C. P. Kingsbury, of the Ordnance Department, U. S. Army, to vacate, in behalf of the United States, the premises occupied by me on the island of Rock Island, in this State, on or before the first day of November, A. D. 1864, in conformity to instructions from the Chief of Ordnance, United States Army, at Washington, D. C., by virtue of and pursuant to an act of Congress approved April 19th, 1864. I would represent to you that the premises owned and occupied by me, on said island of Rock Island, are the following, to wit: Lot No. five, (5,) in block No. fifteen, (15,) in that part of the town of Moline known as "Island City subdivision No. one, (1.)" The improvements thereon consist of a post and board fence surrounding the premises, a small framed dwelling-house in good repair, with sheds for fuel, stock, etc. The lot is well stocked with vines, shrubbery, and young fruit-trees. I value the premises, with improvements, at six hundred dollars, ($600.)

Hereto attached please find a certified abstract of title of said lot.

Finally, I would most respectfully request that the United States will at an early day have my claim for damages examined and adjusted.

I have the honor to be, most respectfully, your obedient servant,

NELS JOHNSON.

Brig. Gen'l A. B. DYER,
Chief of Ord., U. S. Army, Washington, D. C.

THE CLAIM OF DAVID SEARS

was for lots 11 and 12, block 10, in Island City. The title to this property was conveyed by purchase from D. B. Sears. The claimant's petition for re-imbursement by the Government of the above real estate was as follows:

MOLINE, ROCK ISLAND CO., ILLS.,
October 27th, 1864.

GENERAL: I beg leave to represent to you that in June last I was notified by C. P. Kingsbury, major of Ordnance, U. S. Army, to vacate, in behalf of the United States, the premises occupied by me on the island of Rock Island, in this State, on or before the first of Nov., 1864, in conformity to instructions from Brig. Gen. Geo. D. Ramsay, then Chief of Ordnance, U. S. Army. I would further represent to you that the premises then and now owned and occupied by me on said island are as follows, to wit: Lots Nos. 11 and 12, in block No. 10, in that part of the town of Moline known as "Island City subdivision No. 1."

The premises are surrounded by a good post and board fence, have a good well on them, and are well stocked with choice fruit-trees and shrubbery.

I value the said premises at eight hundred dollars, ($800.00.) And I most respectfully request that the United States will at an early day have my claim examined and adjusted.

I have the honor to be, very respectfully, your ob't servant,

DAVID SEARS.

Brig. Gen. A. B. DYER,
Chief of Ord., U. S. Army, Washington, D. C.

THE CLAIM OF ROBERT WELCH

was for lot 8, block 9, in Island City, with improvements thereon consisting of a small frame dwelling-house, shrubbery, and fruit-trees. The title to this property was also derived by purchase from D. B. Sears. His petition to the Chief of Ordnance for re-imbursement of his property taken by the Government was as follows:

MOLINE, ROCK ISLAND CO., ILLS.,
January 16th, 1865.

GENERAL: I beg leave to represent to you that I was in June last notified by C. P. Kingsbury, maj. ord., U. S. Army, to vacate, in behalf of the United States, the premises occupied by me on the island of Rock Island, in this State, on or before the first day of Nov., A. D. 1864, in conformity to instructions from the Chief of Ord., U. S. Army, by virtue of and pursuant to the provisions of an act of Congress approved April 19th, 1864. I would further represent to you that the premises owned and occupied by me on said island of Rock Island are the following, to wit: Lot No. eight, (8,) in block No. nine, (9,) in that part of the town of Moline known as "Island City subdivision No. one, (1.)" The improvements thereon consist of a post and board fence surrounding the premises, a small framed dwelling-house in good repair, a small framed stable and shed, and a good well of water. The lot is well stocked with shrubbery and young fruit-trees, just beginning to bear. I value the improvements at one thousand dollars, ($1,000.) Hereto attached please find a certified abstract of title to said lot. Finally, I would most respectfully request that the United States will at an early day have my claim examined and adjusted.

I have the honor to be, most respectively, your ob't servant,

ROBERT WELCH.

Brig. Gen. A. B. DYER,
Chief Ord., U. S. Army, Washington, D. C.

The claims of James Robinson, Daniel Jones, and Peter Peterson were for lots owned by them in Island City, the title to which had been obtained by purchase from D. B. Sears. The parties furnished proper abstracts of title to their property, which papers were submitted to the commissioners.

CLAIM OF THE TOWN OF MOLINE.

The town of Moline was the owner of a bridge and roadway connecting Mill street, in the town of Moline, with the head of the island of Rock Island, and thus formed the means of communicating with the subdivision of the town of Moline known as Island City, and, farther on, with Benham's Island, where the steamboat-landing was situated.

Under the act of Congress approved April 19, 1864, the bridge was taken possession of by the United States; hence the claim for compensation.

The commission met at Rock Island arsenal about October 1, 1866, and examined witnesses as to the value of property taken by the United States, and the claims of the Moline Water-Power Company and Chicago, Rock Island and Pacific Railroad Company. The testimony taken is voluminous, and, generally, not very interesting to parties not concerned. The following is a condensed abstract of the testimony, and gives, generally, only the value of the property as estimated by each witness or the mean amount testified to by the several witnesses in a particular case.

In the case of Mr. D. B. Sears, George W. Pleasants, the claimant's attorney, summed up the testimony before the commissioners as follows:

In the matter of the appraisement of the property of David B. Sears, upon and adjacent to Rock Island, Ills., taken by the United States for military uses.

To the Board of Commissioners in the matter aforesaid, Washington, D. C.:

The undersigned, of counsel for Mr. Sears, begs leave to submit the following analysis of the testimony herein:

And first of that taken before the commissioners in person, embracing twelve wit-

nesses, who may be classified and grouped according to their comparative weight, as follows:

1. *Davis, Armstrong, and Parker,* the mayor and two attorneys of Davenport, Iowa: These are of the very least weight, for want of qualification by knowledge either of the subject generally or of the particular property in question. No reason appears why either of them, more than any other respectable gentleman residing anywhere in this vicinity, should be called at all upon any question here involved. Like all such, they know something of the property, for its location and character are too conspicuous wholly to escape observation, but are not specially qualified to appraise real estate anywhere, much less mills, water-power, and water-lots in Moline. Their experience and business are in another line, and their residence in another jurisdiction. They admit their comparative ignorance and incompetency in this case. Mr. Davis for that reason wholly declines to express an opinion as to values, and Mr. Armstrong also, except as to the land, which he thinks worth, as such, $75 @ $100 per acre; and Mr. Parker's estimates are so unreasonable, as shown by every other witness upon the same points, that they must be excluded from serious consideration. Indeed, no reason is attempted to be given for any of them except that of the land, and that is inapplicable; for they are not farming-lands above the town, but *lots in* the town—a busy, growing, wealthy town—and most eligibly located either for residence or for business therein.

2. *Griggs and Goldsburg* are somewhat better qualified, but only by difference in the degree of their knowledge of real estate generally, growing out of their business, which brings them more in contact with such property. But they also reside and do business in Davenport. They have no particular relations with Moline, and no special occasion or inducement to know the value of property there. Such property as this is not commonly for sale, because it does not commonly exist in the neighborhood, and there is none on the Iowa side of the river. They have not carefully examined this property or considered the elements of its value, and could not be expected to estimate it accurately at a glance, but must get at it as a *guess*, or as a conclusion hastily drawn, and considerably removed from any certain or reliable premises. They do not possess anything more. Mr. Goldsburg estimates the whole, in mass, at $80,000; Mr. Griggs, by items, at about $109,000; thus giving as the average, $94,500. No data are given, except that the latter estimates the water-power at $75,000, upon the assumed basis of an annual rental of $5,000; which is much too low, as otherwise fully shown.

3. *Hakes, Harper, Guyer, and Reynolds.*—These are all old residents of Rock Island, nearer to the property in question, in the same State and county, and on the same side of the river, and having, therefore, closer relations, both business and social, with the people of Moline, and a better acquaintance with property there and its value. Furthermore, they are all men of character and substance, who have bought, sold, and own large amounts of real estate in the neighborhood of their residence. Their opinions upon such a subject are justly entitled to a high degree of confidence. It is, nevertheless, evident that in this case they speak generally and from general knowledge. When examined they had not prepared themselves by special examination of the property, or any other means by which they could speak definitely, confidently, and with clear and specific reasons. They had no sufficient opportunity and no occasion so to do. Hence the hesitation and generality of their statements, especially those of Messrs. Guyer and Reynolds. Thus, speaking from such general acquaintance with this, and with other property more or less like it in the same general locality, they appraise it, respectively, at $115,000, $100,000, and $150,002, giving an average of $126,000 in round numbers.

4. *Keator, Candee, and Gould.*—These are such as those in the last preceding group, with still better qualifications, however, in this: that they have long resided and operated mills in the town of Moline and in sight of the property and operations of Mr. Sears. They are all stockholders in the Moline Water-Power Company, and necessarily well acquainted with all the property in question. But like others, they had not specially prepared themselves for this examination, and give us conclusions without any full or detailed statement of the reasons. Mr. Gould gives us the number of inches of water now used at Mr. Sears's dam, as he understands, and the current rate, and Mr. Candee states the reason of the recent reduction from $1 to 75 cents per inch at the Moline dam, viz, the obstruction in their pond. These witnesses appraise the property as follows:

Keator:

Land on Rock Island, ($100 per lot)	$15,000 00
Benham's Island, with buildings, except mill	20,000 00
Mill	25,000 00
Water-power, ($75,000@$80,000,) say	75,000 00
	135,000 00

Candee:	
Land on Rock Island, ($100 per lot)	$15,000 00
Houses on Rock Island, $500 each	2,000 00
Benham's Island and landing	10,000 00
Mill	25,000 00
Other buildings on Benham's Island	4,550 00
Water-power	100,000 00
	156,550 00
Gould:	
Land on Rock Island, ($125 per lot,) say	$19,000 00
Benham's Island	15,000 00
Mill	20,000 00
Other buildings	3,600 00
Water-power	75,000 00
	132,600 00
Average, (in round numbers)	141,000 00

The undersigned heard the testimony of the aforenamed witnesses once read, somewhat hurriedly, by the clerk of your board, and noted the figures as read. He believes that the above analysis fairly represents it.

That of Mr. Guyer appears confused, as the witness himself probably was, and the explanation of Mr. Candee's "correction" of his estimate of the water-power from fifty to one hundred thousand dollars is, perhaps, not distinctly set forth. I am informed that he stated his estimate of fifty thousand as of the power at each end of the dam. There must be some explanation of so wide a difference, and the commissioners, or some of them, their attention being called to it, will doubtless recollect it.

Upon the whole of the foregoing these general remarks may be made:

1st. That the appreciation of the property by the witnesses is in direct proportion to their knowledge of it and their qualifications to judge of its value.

Thus we have the second group averaging at $94,000.00, the 3rd $126,000.00, and the 4th $141,000.00, and this observation is further verified in the other testimony hereinafter considered. (The first group knew too little of it, and were otherwise too poorly qualified to venture on any estimate of the bulk of the property, excepting Mr. Parker, who helps to prove the truth of this remark, but nothing more.)

2nd. That the witnesses, as repeatedly above noticed, state their conclusions only, and in round numbers, without date, reasons, or specific facts from which they are drawn. Considering the value of the property involved, even according to the lowest estimate of it, its prominence in a populous neighborhood, and the facility and readiness with which all the elements and criteria of its value might have been ascertained and stated, this was not to be expected; certainly not of the claimant of so considerable a sum as Mr. Sears.

It can be explained only by the facts (not distinctly appearing in evidence, but stated to the board at the time, and highly probable from all the circumstances) of his ignorance of the method to be pursued and the absence of his counsel.

From the meeting of the Commissioners here, he expected and desired that they would personally examine the property, see for themselves its condition, extent, and relations, and from such examination and the testimony of witnesses as to facts which could be ascertained by such examination, and which ought to weigh in arriving at a conclusion, form their own opinion as to values. With their opinions, so formed, he would have been entirely satisfied. Hence, he took no pains to show his property to others and call their attention to its points for the purpose of making them witnesses. He preferred that the investigation sh uld be wholly conducted and the witnesses selected by the commissioners. The facts which he supposed they would desire to know were such as these: the necessity of the works constructed to the creation of the power, the cost and adequacy of these works, the capacity and condition of the pond, the amount of head and fall and its variations at different seasons and in different stages of water; the amount and availability of power now furnished, the demand for it, the current value of it, the practicability and cost of increasing the present capacity; the amount and profit of business now done and likely to be done at the landing, the value of the lots, buildings, and improvements, considering their quality and adaptations to be ascertained by comparison with other like property, and other means usual and proper in such cases. The only interest he could have in the witnesses to be called was to see that they were such as knew the facts and would be able to state them clearly. Such facts clearly shown would enable the commissioners, with such observations as they could easily make, to determine the value of the property. He was surprised and disappointed, therefore, when witnesses were called

suddenly and without preparation on their part, and who, however long and well acquainted with the property in a general way and as neighbors to it, were not able to state facts on the points above referred to, and was embarrassed for want of counsel in dealing with them. In the extended time kindly allowed him for that purpose, he has honestly endeavored to establish these facts by the testimony of witnesses who know them and may be relied on to state them fairly. The character and standing of these witnesses are a sufficient guarantee, and it must be apparent from their testimony, hereinafter considered, that if those above named had been asked in relation to these or other good reasons for the conclusions they stated, they must have answered either that they did not know them or that the facts were as stated by those subsequently examined. Their conclusions should be considered in the light of facts since brought out, though not then known to them.

3rd. It is further suggested that witnesses appraising property from a general or superficial knowledge of it and in ignorance or uncertainty as to those facts which constitute the real elements and the measure of value, are more apt to underestimate than to overestimate. Especially is this so when the property is actually and in the opinion of the witness of very considerable value. The oath induces hesitations and cautions. It is considered safer, if he must guess at all, to guess under than over the true amount. Pride of opinion is less severely wounded in the case of error on that side than on the other.

I proceed now to consider the testimony of witnesses examined subsequently, by leave of the board, and herewith submitted, being all that could be taken within the time limited, by reason of the delay of the return of the undersigned. Indeed that of three of these, Mr. Perkins and the Messrs. Gault, was taken before his return, under apprehension that further delay on account of his absence might involve the loss of some testimony deemed important. These witnesses are fourteen in number—one farmer, one contractor of public works, three millwrights, and six manufacturers and mill-owners, (besides two sons and a clerk of Mr. Sears, whose opinions as to value, on account of their relation to him, were not asked.) All of them, except the first two above referred to, long residents and doing business in the town of Moline and in connection with water-power there—prominent in that community for enterprise, judgment, and integrity, owners of real estate, well acquainted generally and many of them minutely with the property in question, and as likely to know and fairly state its real value as any equal number of men as could be produced. The other two have also resided in the near neighborhood and know the property well ever since the dams were built, and one of them (Mr. Reynolds) has carefully and thoroughly examined it since he testified before the board.

Mr. Stokes, also, is one of the early settlers of the neighborhood, a large land-holder, long engaged in active business with the people of the town, and as well acquainted with the premises as any farmer in the vicinity.

With reference to this testimony, as well as to the character and relations of the property, it may be most conveniently considered in separate parcels: (1st.) The lots on Rock Island. (2d.) The improvements thereon. (3d.) Benham's Island. (4th.) The improvements thereon; and (5th.) The water-power with its appurtenances.

Not all of these witnesses testify as to each parcel, but the whole of the testimony that does relate to each, and is at all material, will be fairly recapitulated in its proper connection.

1. *The lots on Rock Island* are one hundred and fifty-seven (treating block No. 4 as four lots though not so platted) remaining unsold of "Island City subdivision No. 1" of the town of Moline. The whole tract included thirty-five acres and a fraction, and out of it sixteen lots have been sold by Mr. Sears. This parcel is appraised by the witnesses, respectively, as follows:

Mr. Perkins:	
6 water-lots, at $500 each	$3,000
29 other lots, at $200 each	5,800
122 other lots, at $175 each	21,350
	30,150
Mr. Gault, S. F.:	
6 water-lots, at $4,000 each	$24,000
29 other lots, at $250 each	7,250
122 other lots, at $150 each	18,300
	49,550

This witness evidently estimates the water-lots in view of the contemplated improvements frequently referred to in the testimony shown on the plat, just as do those produced by the part of Messrs. Stevens, Huntoon & Wood, as to their two lots adjoining these, and their testimony supports this.

See also that of Mr. Wood herein as to the comparative value of these and theirs.

Mr. Reynolds appraises them in mass at	$22,250
Mr. Dimock, 157 lots, at $150 each	23,550
Mr. Wheelock, 157 lots, at $150 each	23,550
Mr. Sickels, 5 water-lots, at	10,000
other lots and houses	25,000
Deduct for houses the most liberal estimate, say	5,000
And we have	30,000

The foregoing is the sum of all that relates to this parcel—six witnesses whose average estimate is found to be $29,841.66.

2. *The improvements on said lots* include four dwelling-houses, barn and shed, 207 bearing fruit-trees, 11 non-bearing, 50 bearing grape-vines, all of choice quality and in thrifty condition, and 57 maple and other set shade-trees, also in good condition, and of fair size. (See the testimony of William Sears, who lately counted them.) But only the buildings and 200 trees are estimated by the witnesses, who did not know the precise number, and some of them omit the trees altogether, although it seems from their statements that their valuation of the lots was exclusive of all improvements thereon. The same six witnesses testify as to this parcel, and as follows, respectively:

Mr. Perkins:		
4 houses, at $500 each	$2,000	
Barn and shed	400	
200 trees, at $5 each	1,000	
		$3,400
Mr. Gault:		
4 houses, at $500 each	$2,000	
Barn and shed	400	
200 trees, at $6 each	1,200	
		3,600
Mr. Reynolds:		
All the buildings at	$2,100	
Trees omitted, but say $2 each	400	
		2,500
Mr. Dimock:		
Appraises in mass at		2,500
Mr. Wheelock:		
Buildings	$2,500	
Say for trees, omitted	400	
		2,900
Mr. Sickels includes improvements in lots as above, but allows the least, say		2,550
Average valuation		2,900

3. *Benham's Island*, containing two acres and over, on which is the only steamboat-landing for Moline.

Mr. Gault appraises it at	$10,000
Mr. Reynolds appraises it at	12,000
Mr. Dimock appraises it at	12,000
Mr. Wheelock appraises it at	12,000
Mr. Stokes appraises it at	20,000
Mr. Sickels appraises it at	20,000
Averaging	14,333

4. The improvements thereon (exclusive of landing and water-power) consisting of a flouring-mill, a dwelling-house, outhouses, and three warehouses. These are estimated by seven of the witnesses, and, respectively, as follows:

Mr. Perkins:		
The mill at	$24,000	
Dwelling	1,000	
Outhouses	500	
Warehouses	3,300	
		$28,800
Mr. Gault, (W. F.:)		
Mill	$25,000	
Dwelling	1,000	
Outhouses	500	
Warehouses	3,300	
		29,800

Mr. Gault, (Sam'l:)		
Mill	$22,000	
Dwelling	1,000	
Outhouses	500	
Warehouses	3,300	
		$26,800
Mr. Reynolds:		
Mill	$25,000	
Dwelling	800	
Outhouses	500	
Warehouses	3,200	
		29,500
Mr. Dimock:		
Mill	$30,000	
Dwelling	900	
Outhouses	600	
Warehouses	3,400	
		34,900
Mr. Wheelock:		
Mill	$26,000	
Dwelling	800	
Outhouses	600	
Warehouses	3,200	
		30,700
Mr. Sickels:		
Estimates mill only at	$20,000	
Say for other improvements	4,700	
		24,700
Making an average of		29,314

5. *The water-power*, made by a main dam between Rock and Benham's Islands, wing-dam from the latter, above and below, bank-walls and excavations. There are six witnesses who give us estimates, each in round numbers, with data, and several others who furnish data without expressing a conclusion.

Mr. Gault estimates it in its present condition at	$100,000
Mr. Reynolds estimates it at $80,000 on the basis of its present capacity, but in view of its susceptibility, at	120,000
Mr. Dimock	70,000
Mr. Swan	100,000
Mr. Stokes	100,000
Mr. Sickels	120,000
Giving an average of	101,000

While these witnesses differ in their general conclusions, as might be expected, they substantially, nay, almost exactly, agree among themselves, and with all others who testify in relation to them, as to the facts upon which a just conclusion must be based, which are these:

1. That the structures which make the power are very thoroughly built, upon solid foundation, of proper and sufficient material, and fully adequate for the purpose contemplated, having withstood for twenty years, without a single break, the pressure and action of all the forces to be resisted, are all necessary to the creation of the power, in good condition, and likely to endure permanently.

2. That the pond is of ample capacity for the dam as the latter now is, or as it may be extended—not obstructed, nor likely to be, from any cause now in operation, but secured against it—and is a safe and valuable harbor for logs.

3. That the head obtained by these works is comparatively steady and reliable, and sufficient to afford the requisite power throughout the year, excepting only about thirty days in the season when there is least occasion for a profit in the use of such power.

4. That there are now in the dam not less than 6,600 inches of water—indeed, the most satisfactory proof is of 6,700, for Timothy Wood and William Sears speak from actual knowledge derived from measuring the wheels and seeing them measured, helping to put them down, and knowing the patterns—and they swear to 2,800 inches at the flouring-mill and 3,900 at the other.

5. That so little is the head affected by the drawing off from the pond the amount now used, that double that amount could be used in the present condition of the dam, and by an expenditure of from twenty-five to fifty thousand dollars it could be quadrupled without impairing the power for use or for rent.

6. That the present rate for water-power at Moline Dam is seventy-five cents per inch, the lessee taking all risks, and is reduced from former rate of one dollar per inch per annum, on account of obstructions in pond there, which lessens the power and makes it more variable.

7. That the power at Sears's Dam is better than that at Moline Dam, more uniform and reliable, with structures to maintain it which have never failed, and an ample pond, free from obstruction and from liability to obstruction, to supply it, while the other dam has repeatedly gone out and its pond is filling up. Probably the general impression has been the other way, for obvious reasons. The Moline Dam is the most extensive; more labor and money have been expended on it; it is owned by an influential company; is nearer the business center of the town, and more exposed to observation; and has been the subject of litigation and sale to give it notoriety. Perhaps, also, it may have been equal or even superior to Mr. Sears's before the formation of the bar in the pond; but it is submitted with confidence, upon the testimony herein and the reasons given, that the latter, though lesser in extent, is now better in quality.

8. That there is now, and is likely to continue to be, a demand for power there, at the rates stated, equal to the supply now furnished or that can be furnished.

Upon these facts, all established by several, and most of them by nearly all the witnesses—each by all who give any testimony in relation to it, and not one of them contradicted by any, would seem of themselves to warrant the valuation of this item of the property last above set forth. For the present capacity, without further expense to the proprietor, is at least (6,700×2) 13,400 inches, all in present demand at 75 cts. per inch, which would give an—

Annual income of	$10,050 00
Add its value as a harbor for logs, lowest	800 00
And we have, at the lowest calculation	10,850 00

But its susceptibility of improvement and extension, at so small a proportion of expense to the income from it, ought also to be considered as an element of present value. Nor does there seem to be a good reason for anticipating only 75 cts. per inch as the price of power. It has been a dollar, and was reduced at the Moline Dam for a reason that does not apply here. Some of the witnesses say it is well worth a dollar, absolutely; others, that it is as well worth a dollar at Sears's Dam as 75 cts. at the other—and parties are using steam because water cannot be had; the water at a dollar an inch is materially cheaper than steam, with coal at 16 cts. per bushel, which is as low as it can be furnished.

Mr. Dimock's estimate—$70,000—the lowest that is made, is made so low because he would not invest in such property without assurance of a yield of twenty per cent. per annum. That ought to depend on the probable permanence of the property, and of the demand for the power at paying rates; and perhaps he is influenced by his observation and experience with the Moline Dam, which has rapeatedly gone out, and is more liable to expense for maintaining it than this. The fact that this power has been leased heretofore at lower rates ought not to affect the award now to be made, because that fact is sufficiently accounted for and shown to be inconsistent with the present claim as to value. It was so leased by agreement of the owner, who might do as he would with his own; but if the Government takes it from him without his consent, it should pay him the reasonable value, without regard to former leases. The time, the circumstances of the property and the parties, the general state of business, and advantages future and other than the amount of rent then fixed for a time, sufficiently explain this matter as to the lease of Stevens, Huntoon & Wood. (See Wood's answer to the eighth interrogatory.) The only other lease was to a firm composed of the proprietor and his own sons, and therefore the rent reserved was only nominal. Besides, it is shown by the testimony of Wood himself in that case, and by the proposition actually made to Gen'l Rodman in the other, that these very lessees would be glad to hold on to the power they use at the rates shown to be now current and reasonable.

A better criterion of value than rent heretofore reserved, although not absolutely reliable, is the cost it would now require to create the property; especially in such a case as this, in which time has not damaged but improved by consolidating the works, and in which there was no waste of work—none unnecessarily built.

Mr. Reynolds, as competent and creditable a witness as could be produced on this subject, after personal examination and measurement and rather underestimating, shows the cost, at present rates for such work as he finds this to be, not less than $97,066.50. He would not, with all his facilities and experience, contract to build them for any less. This is exclusive of the work on the landing. If the Government wants the property as a water-power, this would seem to be the very lowest estimate at which it could with any show of justice take it; if it does not, Mr. Sears does, unless he gets for it what he regards as its reasonable value.

A further approximate test has also been furnished by the balance-sheet of D. B. Sears and Sons, verified by the oath of the book-keeper and the United States assessor

and collector. This shows the net earnings or income, after deducting the lawful interest upon all moneys invested, and all expenses, including rent and labor of the partners themselves as well as of others. Such an exhibit for the last three years—ever since the recovery of business from the depressing effect of civil war—averaging at least $11,000 per annum, indicates a valuable property.

The foregoing presents all the possible legitimate means of proving value of which the nature of this or any like case admits. The extent, present condition, and actual cost of the works, the capacity and susceptibilities of the power, the demand for it, the current and reasonable price and value of it to use or to rent, and the actual earnings as nearly as they can be ascertained, are all definitely and fully proved; and with these the opinions carefully formed upon these and all other facts and circumstances properly bearing upon the question, of so many witnesses so well qualified to judge, with reasons for their judgment, and all these reasons and other data supporting and confirming these opinions, ought to be conclusive. The witnesses include almost every mill-operator on either dam, indeed, every one except Mr. Deere, of the plow-factory, who was absent when called on to be examined, and whose testimony could not afterward be taken for want of time, and others most conversant through their business and acquaintance with the property and its worth. It is not at all probable that if the testimony of a hundred others, or any greater or lesser number, qualified, could have been taken, the average estimate would have been thereby reduced a single dollar. The average appraisement by these is as follows:

Of lots on Rock Island and improvements	$32,741 66
Of lots on Benham's Island and improvements	43,647 00
The water-power and appurtenances	101,000 00
Of the entire property	177,388 66

Including the testimony of Messrs. Keator, Candee, and Gould, above shown to be less reliable, it only reduces the average estimate to $160,194.33.

These results demonstrate the fairness of Mr. Sears. He offered it for $160,000, and it is now proved that he did not seek to take any advantage because he was dealing with the Government. He offered it for what he thought it worth to himself or any other private individual. His neighbors—every one from the place where the property is, and best acquainted with it—confirm, by their oaths and in the exercise of an intelligent and unbiased judgment, the justice of his claim. There remain but two items, to which attention is called, without knowing what may be the views of the commissioners as to their duty or power in respect to them:

1. The damage to Mr. Sears, by reason of the breaking up of his business, amounting, in the opinion of witnesses, to $10,000 or $12,000, or about one year's profits of the business at the mill. His brand is well known and highly estimated. He could not re-establish such a business, even with the fair proceeds of this property, within less time than one year; or, if he could purchase such a business already established, he must pay for the good-will, as a separate item, not less than the amount stated.

2. His claim for interest on the value of his property, from the time it was taken by the Government. The justice of this is apparent from the mere statement. All but Benham's Island were taken in November, A. D. 1864, and the Government has ever since collected the rents from it. Benham's Island was so taken on the first day of September last, since which time rent for it has been collected or charged by United States. His offer has been before the War Department all this time. Having failed, as yet, either to pay or say how much and when it would pay, it ought, when the amount is determined by means prescribed by the Government, without his consent, to allow him lawful interest on such amount from the time when it should have been paid, that is, when the property was taken.

All of which is most respectfully submitted.

(Signed) GEORGE W. PLEASANTS,
Att'y for D. B. Sears.

Some twenty-five witnesses were examined by the commissioners relative to the value of the lands and buildings pertaining to the "Davenport place." Twenty-two of these estimated the value of the land as follows:

Eleven at $500 to $600 per acre.
One at $400 to $500 per acre.
Five at $100 per acre.
Three at $125 per acre.
Two at $200 per acre.
Three at $75 per acre.

The other witnesses estimated the buildings to be worth from $7,000 to $8,000.

Fourteen witnesses were examined before the commissioners relative to the value of the property pertaining to Stephens, Huntoon & Wood. The lots, mill with machinery, paint-shop, and other buildings were each separately taken into consideration, and considerable difference in regard to the value of each item was elicited before the board.

The value of the minor claims of David Sears, Robert Welch, Daniel Jones, Peter Peterson, Nels Johnson, and James Robinson appears to have been determined by a comparative valuation of similarly located lots pertaining to David B. Sears, from whom the property had been purchased by the different claimants.

All of the parties concerned had abstracts of their titles to their respective property prepared; these titles were examined by the United States district attorney, who certified that the claimants were vested with good and valid titles to the premises described, and in this the Attorney-General of the United States concurred.

As regards the claim of the town of Moline, the action taken by the board of commissioners is fully set forth in the report of the commissioners to the Chief of Ordnance.

CLAIM OF THE CHICAGO, ROCK ISLAND AND PACIFIC RAILROAD COMPANY.

There was no claim presented to the board of commissioners by this company, except that contained in the paper signed by F. H. Tows, marked "R. R. No. 1," and attached to the report of the commission. For an account of the manner in which this company acquired its right of way on the island, and some history of attempts made by the Government to remove the company, and the action taken by the Ordnance Department and Congress to procure the removal of the railroad to the west end of the island, see Chapter VI on the subject of the Rock Island bridge.

On the 19th of October, 1866, the commission adjourned to meet in Washington, and on the 4th of February, 1867, submitted its report to the Chief of Ordnance, as follows:

WASHINGTON, D. C., *February 4th, A. D.* 1867.

General A. B. DYER,
Chief of Ordnance, Washington, D. C.:

GENERAL: We, the commissioners appointed by the President under the acts of Congress approved April 19th, 1864, and June 27th, 1866, have the honor to submit herewith the record of our proceedings and to report the result of our deliberations, as follows, viz:

In the matter of compensation to be paid to persons owners of lands on Rock Island taken by the United States for military purposes:

The following extract from the record gives the names of all the claimants to such lands, the findings of the commissioners as to title, and the several sums awarded as full compensation to the claimants:

[EXTRACT.]

"OFFICE OF THE ROCK ISLAND COM'S'N,
"*Washington City, January 11th,* 1867.

"The board then took under further consideration the claim of George L. Davenport and Susan M. Goldsmith, and after full and mature consideration the board finds that Susan M. Goldsmith was the owner of a life estate in the southeast fractional quarter of section twenty-five, (25,) township eighteen (18) north, of range two (2) west, of

the fourth (4) principal meridian, and finds that George L. Davenport was the owner in fee of the aforesaid tract of land, with the appurtenances thereunto belonging, to take effect in possession on the termination of the said life estate of the said Susan M. Goldsmith at the time the same was taken possession of by the United States.

"The board adjudges the true value of said land, together with all the appurtenances thereunto belonging, to be forty thousand seven hundred and forty dollars, ($40,740;) and the board does therefore *award* to the said George L. Davenport and Susan M. Goldsmith, joint claimants, the said sum of forty thousand seven hundred and forty dollars, ($40,740,) with interest at six per cent. per annum from this date of January 11th, 1867, to the time of payment. In conformity with the request of the claimants, through their counsel, the board makes no separate awards for the respective interests of said claimants.

"CLAIM OF THE CITY OF ROCK ISLAND.

"The board then took under full consideration the claim of the city of Rock Island, Illinois, for Wilson's Island, a certain bridge, roadway, and embankment, and approaches leading thereto, taken possession of by the United States. After full and mature consideration, the board finds that the city of Rock Island, Illinois, was the owner in fee of Wilson's Island, of a certain bridge, roadway, and embankment leading from the city of Rock Island across Wilson's Island, and of the approach, or certain strip of land leading from Illinois street, in the city of Rock Island, to the aforesaid bridge, roadway, and embankment, at the time the same was taken possession of by the United States; and the board adjudges the true value of said island, bridge, roadway, and embankment, and the aforesaid approach from Illinois street, together with all the appurtenances thereunto belonging, to be fourteen thousand three hundred and fifty-seven and $\frac{70}{100}$ dollars, the aforesaid sum being the actual cost of said property to the city of Rock Island, including the cost of presentation of the claim; and the board does therefore award to the said city of Rock Island the said sum of fourteen thousand three hundred and fifty-seven and $\frac{70}{100}$ dollars, ($14,357 $\frac{70}{100}$,) and in consideration of the use of the bridge, roadway, and embankment by the citizens of Rock Island, and that expenditures for repairs having been made by the United States, the board does not award interest previous to this date, but does award interest on the aforesaid sum at the rate of six per cent. per annum from this date of January 11th, A. D. 1867, to the time of payment.

"CLAIM OF DAVID B. SEARS.

"OFFICE OF THE ROCK ISLAND COM'S'N,
"*Washington City, Jan'y 15th*, 1867.

"The board then took under further consideration the claim of David B. Sears, and, after a full and mature consideration, the board finds that David B. Sears was the owner in fee of Benham's Island, of the mill thereon, and of about thirty-one acres of land, more or less, situated on the upper or eastern end of the island of Rock Island, lotted and known as part of Island City subdivision No. 1 to the town of Moline, together with the water-power, and all the appurtenances to the several parcels belonging, being all the property and interest of said D. B. Sears at or adjacent to the head of Rock Island at the time the same was taken possession of by the United States, and the board adjudges the true value of said land, together with all the appurtenances thereunto belonging, to be one hundred and forty-five thousand one hundred and seventy-five dollars, ($145,175,) and the board does therefore award to the said David B. Sears the said sum of one hundred and forty-five thousand one hundred and seventy-five dollars, ($145,175,) with interest from this date of January 15th, 1867, at six per cent. per annum, until time of payment.

"CLAIM OF STEPHENS, HUNTOON & WOOD.

"OFFICE OF THE ROCK ISLAND COM'S'N,
"*Washington City, January 16th*, 1867.

"The board then took under full consideration the claim of George Stephens, Jonathan Huntoon, and Timothy Wood, parties under the name and style of Stephens, Huntoon and Wood, and all the matters and testimony pertaining to said claim were read to the board, and, after full and mature consideration, the board finds that George Stephens, Jonathan Huntoon, and Timothy Wood, partners under the name and style of Stephens, Huntoon and Wood, were the owners in fee of lots one and two, block thirteen, and lots four, five, and six, block twelve, in that part of Moline known as Island City subdivision No. 1, together with the mill, shops, buildings, leasehold of water-power, and all of the appurtenances thereunto belonging, being all the property of the said claimants, at or upon or adjacent to the head of Rock Island, at the time the same was taken possession of by the United States; and the board adjudges the true value of said lands, together with all the appurtenances thereunto belonging, to be twenty-eight thousand two hundred and seventy dollars, and the board does therefore award to the said George Stephens, Jonathan Huntoon, and Timothy Wood the said sum of twenty-eight thousand two hundred and seventy dollars, ($28,270.00,) with interest at the rate of six per cent. per annum from this date of January 16th, 1867, to the time of payment.

"CLAIM OF JAMES ROBINSON.

"The board then took under full consideration the claim of James Robinson, and, after full and mature consideration, the board finds that James Robinson was the owner in fee of lot No. thirteen (13,) block No. 10, in Island City subdivision No. 1 to Moline, upon Rock Island, at the time the same was taken possession of by the United States, and the board adjudges the true value of said land, together with all the appurtenances thereunto belonging, to be twelve hundred dollars, ($1,200.00,) and the board does therefore award to the said James Robinson the said sum of twelve hundred dollars, ($1,200.00,) with interest at the rate of six per cent. per annum from this date of January 16th, A. D. 1867, to the time of payment.

"CLAIM OF PETER PETERSON.

"The board then took under full consideration the claim of Peter Peterson, and, after full and mature consideration, the board finds that Peter Peterson was the owner in fee of lot No. 4, in block eleven, (11,) in Island City subdivision No. 1 of the town of Moline, upon Rock Island, at the time the same was taken possession of by the United States, and the board adjudges the true value of said land, together with all the appurtenances thereunto belonging, to be nine hundred ($900.00) dollars; and the board does therefore award to the said Peter Peterson the said sum of nine hundred dollars, ($900.00,) with interest at the rate of six per cent. per annum from this date of January 16th, 1867, to the time of payment.

"CLAIM OF NELS JOHNSON.

"The board then took under full consideration the claim of Nels Johnson, and, after full and mature consideration, the board finds that Nels Johnson was the owner in fee of lot number five, (5,) in block number fifteen, (15,) in the Island City subdivision to Moline, on Rock Island, at the time the same was taken possession of by the United States, and the board adjudges the true value of said land, together with all the appurtenances thereunto belonging, to be nine hundred and fifty dollars, ($950,) and the board does therefore award to the said Nels Johnson the said sum of nine hundred and fifty dollars, ($950,) with interest at six per cent. per annum from this date of January 16th, 1867, to the time of payment.

"CLAIM OF ROBERT WELCH.

"The board then took under full consideration the claim of Robert Welch, and, after full and mature consideration, the board finds that Robert Welch was the owner in fee of lot number eight, (8,) in block number nine, (9,) in Island City subdivision to Moline, on Rock Island, at the time the same was taken possession of by the United States, and the board adjudges the true value of said land, together with all the appurtenances thereunto belonging, to be thirteen hundred dollars, ($1,300,) and the board does therefore award the said Robert Welch the said sum of thirteen hundred dollars, ($1,300,) with interest at the rate of six per cent. per annum from this date of January 16th, 1867, to the time of payment.

"CLAIM OF DANIEL JONES.

"OFFICE OF THE ROCK ISLAND COM.,
"*Washington City, January 17th*, 1867.

"After full and mature consideration, the board finds that Daniel Jones was the owner in fee of lots No. sixteen, (16,) seventeen, (17,) eighteen, (18,) nineteen, (19,) and twenty, (20,) in block No. ten, (10,) in the Island City subdivision to the town of Moline, on Rock Island, at the time the same was taken possession of by the United States, and the board adjudges the true value of said land, together with all the appurtenances thereunto belonging, to be fifteen hundred dollars, ($1,500,) and the board does therefore award to the said Daniel Jones the said sum of fifteen hundred dollars, ($1,500,) with interest at the rate of six per cent. per annum from this date of January 17th, A. D. 1867, to the time of payment.

"CLAIM OF DAVID SEARS.

"After full and mature consideration, the board finds that David Sears was the owner in fee of lots eleven and twelve, in block ten, in Island City subdivision to Moline, on Rock Island, at the time the same was taken possession of by the United States, and the board adjudges the true value of said land, together with all the appurtenances thereunto belonging, to be eleven hundred dollars, ($1,100,) and the board does therefore award the said sum of eleven hundred dollars ($1,100) to the said David Sears, with interest at the rate of six per cent. per annum from this date of January 17th, 1867, to the time of payment.

"OFFICE OF THE ROCK ISLAND COM.,
"*Washington City, January 24th*, 1867.

"The board having taken under further consideration the matter of the Moline Water Company, finds it impracticable to determine as a separate question the damage sus-

tained by that company in the taking of one-half of their water-power by the United States, because of the inseparable character of the interest thus acquired by the United States and that retained by the company. The determination of this question of damage was, however, rendered unnecessary by the negotiating of a transfer of the entire water-power from the Moline Company to the United States, under the act of Congress of June 27th, 1866, appropriating one hundred thousand dollars for the purpose of securing water-power at the head of Rock Island. After a full discussion with the president of the Moline Water-Power Company, the board agreed with him upon a basis for the settlement of all the questions pending between the company and the United States, and respectfully recommend its adoption by the War Department. The basis agreed upon is as follows, viz:

"1st. The Moline Water-Power Company to convey to the United States the fee of the entire Moline water-power, and also to grant to the United States the unrestricted use in perpetuity, without charge, of so much of the bed of the river not already belonging to the United States as may be covered by the pool and wall, necessary to develop the water-power, and ten feet outside of said wall, together with the right of access thereto from the Illinois shore at all times, for the purpose of constructing or of repairing said wall.

"2d. The Government to develop and maintain the power, so far as it can be done with the money heretofore appropriated and that which may hereafter be appropriated by Congress for that purpose.

"3d. The Moline Water-Power Company to have the use in perpetuity, free from all charge for rent or repairs, of one-fourth of the entire water-power developed, and also the right to rent for a specified time at the rate of fifty cents per annum per square inch of water-power, measured by the openings of water-wheels, so much additional power as the Ordnance Department may deem expedient.

"And further, that the company, its lessees, or assigns, shall have the right to place their wheels upon the ten feet outside the wall, provided that the foundation of said wall shall not thereby be disturbed nor the stability of the wall thereby endangered; and also, further, that this granting to the United States of the unrestricted use of the pool, the wall, and the ten feet outside the wall shall not be so construed as in any manner to operate as a bar to the free use and occupancy by the company, its lessees or assigns, of the same premises, for all purposes connected with and incidental to the use of their portion of the water-power, or such as may be leased by them, and such use shall not interfere with or obstruct the United States in the free use of its portion of the water-power.

"4th. The works to be built by the Government for the development of the power to be so arranged as to give the company the free use of all the power herein contemplated to be used by the company, both as to the use of the fourth part, so far as may be practicable without impairing the power in use by the Government to a disproportionate extent, and also to the proposed power to be leased. The openings in the dams intended for the use of the company to be of such size and in such position as the company may elect.

"5th. $60,000 of the present appropriation to be applied to the extension of the present stone dam, on the Moline side, and $10,000 to the extension and repairs of the wing-dam, and removal of such deposits as may be required for the extension and repairs of said wing-dam. The use of the present water-power shall not be unnecessarily obstructed during the construction of the proposed work, nor shall any rent be required until the improvement contemplated by the $100,000 appropriation shall have been made.

"6th. It is also further understood that neither occupant of the above water-power shall have the right to, nor shall allow others to obstruct either pool or water-way by sawdust or bark, or other substances, to the detriment of the water-power or the sanitary condition of the vicinity.

"MOLINE BRIDGE CLAIM.

"The board then took under further consideration the Moline Bridge claim, and, after full and mature consideration, the board finds that the town of Moline, Illinois, was the owner in fee of a certain bridge and roadway connecting the head of the island of Rock Island with Mill street, in the town of Moline, on the main shore, at the time the same was taken possession of by the United States, and the board adjudges the true value of said bridge, roadway, and approach, together with all the appurtenances thereunto belonging, to be two thousand dollars, ($2,000,) and the board does therefore award to the town of Moline the said sum of two thousand dollars, ($2,000,) upon the condition, however, that the United States shall have the free use of the streets of Moline connecting with the bridge, the right to make such alterations in the approach to said bridge as they may desire, and the right to construct for their own use another bridge connecting the island of Rock Island with the town of Moline, at any point the United States may select, and does also award interest on the above sum at the rate of six per cent. per annum from this date of February 1st, A. D. 1867, to the time of payment.

"CLAIM OF J. C. TAYLOR FOR WINNEBAGO ISLAND.*

"The board then took under further consideration the claim of J. C. Taylor for Winnebago Island, and after full and mature consideration of the showings of title submitted by the claimant, filed and marked "N, No. 1, 2, and 3," the board finds therein no sufficient evidence of title to Winnebago Island in the claimant, and the board does therefore make no award to the said claimant.

"ROCK ISLAND RAILROAD AND WAGON BRIDGE.

"WASHINGTON CITY, *February 2nd*, 1876.

"The board then took under further consideration the matter of the railroad and bridge across Rock Island and the Mississippi River.

"After hearing the parties in interest, and after full and mature deliberation, the board suggests that the location of the railroad across the island be changed to the lower extremity of the island, as laid down in the plans of the Ordnance Department, and that the company be granted a permanent right of way across the island, of such width, not exceeding one hundred feet, as may be necessary for the construction of a double track.

"For its suggestions as to the kind of wagon-road that should be established, and the amount and kind of aid that should fairly and equitably be granted toward effecting those objects, the board adopts and recommends the following proposition of the Chicago, Rock Island and Pacific Railroad Company, hereunto attached and marked 'R. R. No. 1,' with the additional condition that the United States shall have the right to connect with the track of the company such side tracks as may be desired for the use of the United States, and at such points as the Ordnance Department may select.

"R. R. No. 1.

"Whereas in pursuance of an act of Congress entitled 'An act making further provision for the establishment of an armory and arsenal of construction, deposit, and repair on Rock Island, in the State of Illinois,' approved June 27th, 1866, this company, by its agent, has been negotiating with the Secretary of War, through the board of commissioners referred to in said act, for the purpose of changing, fixing, and establishing the position of the railroad across Rock Island, and the erection of a railroad and wagon bridge across the Mississippi River, and such agent has reported to this committee the following as the basis of a proposition for the settlement of all questions arising out of the occupancy of the island by the said company, to wit:

"The Government to build, over the main channel of the river, an iron draw-bridge, in accordance with the conditions prescribed in the act of Congress of July 25th, 1866. The frame to be of proper breadth for a double track. The wagon-way to be placed high enough to leave the lower chord for a railroad-track.

"The Government to give the company the right of way over the bridge and across the island, upon the payment of half the cost of the superstructure of the bridge. The bridge to be built with due regard to economy, having reference to strength and durability.

"The company to have five years from January 1, 1867, in which to connect with the new bridge, and to remove its present track across the island and the old bridge and piers from the main channel.

"The company to open wagon-ways, for use of Government, through their present embankment on the island, and remove, as far as practicable, present obstructions to wagon-traffic between the island and city of Rock Island:

"*Therefore, resolved*, That this company will make the proposition aforesaid to the United States, and if approved by the Secretary of War will enter into a contract based upon those general principles.

"OFFICE OF THE CHICAGO, R. I. AND P. R. R. COMPANY,
"*New York, Feb.*, 1, 1867.

"I, F. H. Tows, secretary, do hereby certify that the foregoing is a true copy from the minutes of the proceedings of a meeting of the executive committee of this company, held at the city of New York this day.

"Witness my hand and the seal of the said company hereunto affixed.

[SEAL.] (Sig.) "F. H. TOWS,
"*Sec. C., R. I. & P. R. R. Co.*

"* On all maps attached to this history, this island is called "Papoose Island." This is its old Indian name. It is not known when, by whom, or why the name Winnebago was given to it. As there is a more important island named Winnebago about four miles up the river, to avoid confusion it is thought to be better to return to the old, much prettier, and more appropriate name, Papoose.

"The report required by law to be made by the board to the circuit court of the United States has been made, and the clerk of the board has been directed to deliver it in person to the judge or clerk of said court, and to report the performance of this duty to the Chief of Ordnance.

"The board having finished the business before it will adjourn this day, February 4 1867, *sine die.*

"All of which is respectfully submitted.

(Signed) "J. M. SCHOFIELD, *Maj. Gen'l,*
(Signed) "JAMES BARNES,
(Signed) "SELDEN M. CHURCH,
"*Commissioners.*"

By section 3 of the act of Congress approved April 19, 1864, the commissioners were directed to report to the circuit court within and for the district in which the lands taken possession of by the United States are situated what compensation for the taking of such lands was due to each claimant; and by section 4 of the same act the circuit court, upon the return and examination of the report of the commissioners, was to order the sums awarded by the commissioners to be paid to the claimants. This was done by the parties concerned, and the circuit court for the northern district of Illinois (Judge Drummond) decreed that the several sums awarded to the claimants be paid.

Before payment was made the Secretary of War required that satisfaction should be entered on each decree; that this satisfaction should be recorded with the decree, and that the United States attorney should indorse on each that such satisfaction had been duly recorded. These formalities were complied with, and drafts for the respective awards were issued from the Treasury Department and sent through the Chief of Ordnance to General Rodman, for distribution to the interested parties.

The following is a summary of the awards made by the commissioners, which sums were paid to the claimants during the months of May and June, 1867, together with 6 per cent. interest from the date on which the award was made by the commissioners to the date of payment:

The city of Rock Island	$14,357 20
David B. Sears	145,175 00
George L. Davenport and sister	40,740 00
Stephens, Huntoon & Wood	28,270 00
Robert Welch	1,300 00
Daniel Jones	1,500 00
Peter Peterson	900 00
Nels Johnson	950 00
James Robinson	1,200 00
David Sears	1,100 00
The town of Moline	2,000 00
Total	237,492 20

CHAPTER V.

THE ROCK ISLAND BRIDGE DOWN TO THE TIME IT WAS TURNED OVER TO THE ENGINEER DEPARTMENT, 1867 TO 1869.

The claims of the Chicago, Rock Island and Pacific Railroad Company and their basis—The claims referred to the board of commissioners and a plan of adjustment recommended—Main features of the plan—Text of the act of Congress passed in order to carry out the plan—Appropriations by Congress in 1867 for the bridge and other purposes—Guarantee entered into by the Chicago, Rock Island and Pacific Railroad Company—$500,000 appropriated for commencing the construction of the bridge—Contract made for construction of piers—Letter of General Rodman to the Chief of Ordnance—Construction of bridge according to proposed plan impracticable—Letter from General Rodman to General Dyer on the subject—Reply of General Dyer—Opinions of Judge Advocate-General and Attorney-General in regard to the total outlay of money authorized by acts of Congress—Transfer of the work to the Engineer Department by the Secretary of War—General Warren relieves General Rodman in charge of the work—Disappointment of General Rodman at not being allowed to finish the bridge after making all the plans and estimates for it—Letter of General Rodman to Chief of Ordnance in regard to location of the draw—Resolution of Congress approving General Rodman's plans for the bridge—Description of bridge—Railroad embankment and roadway across the island.

THE CLAIM OF THE CHICAGO, ROCK ISLAND AND PACIFIC RAILROAD COMPANY.

The claim of the Chicago, Rock Island and Pacific Railroad Company to a right of way, and to the lands occupied by the company on the island, and to the right to construct bridges from the main-land to the island was based upon two acts of the legislature of the State of Illinois, (one dated in 1847 and the other in 1851, incorporating and authorizing them to locate a railroad from Chicago to Rock Island,) and upon further action of the same legislature in January, 1853, creating the Railroad and Bridge Company a body corporate, with authority to construct a bridge at or near Rock Island.

An act of Congress of August 4, 1852, granted right of way to all rail and plank road or Macadam and turnpike companies through the public lands of the United States, but excepted from the operation of the act all lands held for public use by improvements thereon, and all other lands except such as are held for private entry or sale and such as are unsurveyed.

It seems to be clear that the lands on Rock Island were among those exempted from the operation of the act; but this act of 1852 is given by Judge McLean in chambers in Washington City, in 1855, as a reason for refusing to grant to the United States an injunction to prevent the Railroad and Bridge Company from constructing their track on the island and building their bridges.

Further, it was held that the States have authority to grant a right of way through public lands (the property of the United States) within the State; but it is questionable whether the lands were then or ever have been since 1816 public lands within the meaning of the act, and whether the acts of the legislature of the State were operative. The motion for an injunction in the case referred to, however, was overruled, but, perhaps, more because the railroad and bridges were a great public benefit, if not necessity, and an advantage to the United States through its proprietorship in the island, than from the arguments given. That a connection with the railroads on the main-land through railroad-bridges and a railroad on the island was a necessary part of the plans for a great arsenal has been felt and understood from the first.

The claims of the railroad company and the wants and necessities of the arsenal were all laid before the board of commissioners, and a plan was finally fixed upon which would satisfy the requirements of both the railroad company and the United States. This plan was drawn up and approved both by General Rodman and the officers of the railroad company, and was recommended by the commissioners, and is given in their report. The main features of this plan were that the railroad company should give up their old right of way across the island and remove their track and bridges; that a new bridge should be built at the extreme west end of the island, the cost of which should be borne jointly by the railroad company and the United States; and that the railroad company should have a right of way over that bridge and across the west end of the island.

The bridge and track across the island were to be so constructed as to fulfill the requirements of the railroad company and be out of the way of the improvements proposed by the Government, and at the same time admit of connecting an arsenal railroad with the railroad company's track, and fulfill the requirements of the arsenal in this respect.

The recommendations of the board of commissioners were approved by the Chief of Ordnance and Secretary of War, and the legislation necessary for carrying out the plans was requested of Congress.

The following act of Congress was passed for this purpose:

CHAPTER 141.—(Approved June 27, 1866.)

AN ACT making further provisions for the establishment of an armory and arsenal of construction deposit, and repair on Rock Island, in the State of Illinois.

That the Secretary of War be, and is hereby, authorized and directed to change, fix, and establish the position of the railroad across Rock Island and the bridge across the Mississippi River at and on the island of Rock Island, so as best to accord with the purposes of the Government in its occupancy of said island for military purposes, and in order to effect this he is authorized to grant to the railroad company a permanent location and right of way on and across Rock Island, to be fixed and designated by him, with such quantity of land to be occupied and held by the company for railroad purposes as may be necessary therefor, and that the said grant and change be made on such terms and conditions, previously arranged between the Secretary of War and the companies and parties in interest, as will best effect and secure the purposes of the Government in occupying the island.

SEC. 2. That the Secretary of War be, and is hereby, authorized to grant to the companies and parties in interest such other aid, pecuniary or otherwise, toward effecting the change in the present location of their road and bridge, and establishing thereon a wagon-road for the use of the Government of the United States to connect said island with the cities of Davenport and Rock Island, to be so constructed as not materially to interfere with, obstruct, or impair the navigation of the Mississippi River, as may be judged to be fair and equitable by the board of commissioners authorized under the act of April nineteenth, eighteen hundred and sixty-four, entitled "An act in addition to an act for the establishment of certain arsenals," and may be approved by him.

SEC. 3. That the provisions of the act approved April nineteenth, eighteen hundred and sixty-four, entitled "An act in addition to an act for the establishment of certain arsenals," be so extended as to include the small islands contiguous to Rock Island, and known as Benham's, Wilson's, and Winnebago Islands.

SEC. 4. That the following sums be, and they are hereby, appropriated out of any money in the Treasury not otherwise appropriated, for Rock Island arsenal, to be applied as follows, viz:

To liquidate claims for property in Benham's, Wilson's, and Winnebago Islands, and for property in Rock Island which has been taken in pursuance of law for military purposes, two hundred and ninety-three thousand six hundred dollars, or so much thereof, and no more, as may be necessary to pay the respective claimants such amounts as may be reported by the board of commissioners authorized by the act of April nineteenth, eighteen hundred and sixty-four, and ordered by the United States circuit court to be paid to each.

To secure water at the head of Rock Island, one hundred thousand dollars.

To erect store-houses for the preservation of arms and other munitions of war, and to establish communication between Rock Island arsenal and the cities of Davenport, Iowa, and Rock Island, Illinois, one hundred thousand dollars.

In 1867 the following act, making an appropriation for the bridge and for other purposes, was passed:

CHAPTER 170.—(Approved March 2, 1867.)

AN ACT making appropriations for the support of the Army for the year ending June thirtieth, eighteen hundred and sixty-eight, and for other purposes.

SECTION 1. For repairs and improvements of armories and arsenals:

For armory and arsenal at Rock Island, Illinois, six hundred and eighty-six thousand five hundred dollars.

For the erection of a bridge at Rock Island, Illinois, as recommended by the Chief of Ordnance, two hundred thousand dollars: *Provided*, That the ownership of said bridge shall be and remain in the United States, and the Rock Island and Pacific Railroad Company shall have the right of way over said bridge for all purposes of transit across the island and river upon the condition that the said company shall, before any money is expended by the Government, agree to pay, and shall secure to the United States, first, half of the cost of said bridge; and, second, half the expenses of keeping said bridge in repair; and upon guaranteeing said conditions to the satisfaction of the Secretary of War, by contract or otherwise, the said company shall have the free use of said bridge for purposes of transit, but without any claim to ownership thereof.

In 1868 the following resolution of Congress was passed to amend the foregoing act:

RESOLUTION No. 60.—(Approved July 20, 1868.)

JOINT RESOLUTION in relation to the Rock Island bridge.

That the act of Congress making appropriations for the support of the Army for the year ending June thirty, eighteen hundred and sixty-eight, and for other purposes, approved March two, eighteen hundred and sixty-seven, be, and the same is hereby, so amended as to authorize and direct the Secretary of War to order the commencement of work on the bridge over the Mississippi River at Rock Island, to connect the said island with the cities of Davenport and Rock Island: *Provided*, That the ownership of said bridge shall be and remain in the United States, and the Rock Island and Pacific Railroad Company shall have the right of way over said bridge for all purposes of transit across the island and river, upon condition that the said railroad company shall pay to the United States, first, half of the cost of the superstructure of the bridge over the main channel and half the cost of keeping the same in repair, and shall also build at its own cost the bridge over that part of the river which is on the east side of the island of Rock Island, and also the railroad on and across said island of Rock Island; and upon a full compliance with these conditions said railroad company shall have the use of said bridge for the purposes of free transit, but without any claim to the ownership thereof; and said railroad company shall, within six months after said new bridge is ready for use, remove their old bridge from the river and their railroad track from its present location on the island of Rock Island: *And provided further*, That the Government may permit any other road or roads wishing to cross on said bridge to do so by paying to the parties then in interest the proportionate cost of said bridge; but no such permission to other roads shall impair the right hereby granted to the Chicago, Rock Island and Pacific Railroad Company, and that the total cost of said bridge shall not exceed the estimate made by the commissioners appointed under the act approved June twenty-seven, eighteen hundred and sixty-six: *And provided also*, That in no case shall the expenditure on the part of the United States exceed one million dollars.

SEC. 2. That in case the Rock Island and Pacific Railroad Company shall neglect or fail, for sixty days after the passage of this resolution, to make and guarantee the agreement specified in the act of appropriation aforesaid, approved March second, eighteen hundred and sixty-seven, then the Secretary of War shall be, and is hereby, authorized and required to direct the removal of the existing bridge and to direct the construction of the bridge aforesaid, and expend the money appropriated for that purpose in said act; and the said Rock Island and Pacific Railroad Company shall not have, acquire, or enjoy any right of way or privilege thereon, or the use of said bridge, until the agreement aforesaid shall be made and guaranteed according to the terms and conditions of said act of appropriation.

All acts or parts of acts inconsistent with these resolutions are hereby repealed.

SEC. 3. That any bridge built under the provisions of this resolution shall be constructed so as to conform to the requirements of section two of an act entitled "An act to authorize the construction of certain bridges, and to establish them as post-roads," approved July twenty-fifth, eighteen hundred and sixty-six.

In accordance with the requirements of the act of June 27, 1866, the following guarantee was entered into between the railroad company and the Secretary of War:

Guarantee by the Chicago, Rock Island and Pacific Railroad Company to fulfill the conditions required by law in regard to the construction of a bridge at Rock Island, Illinois.

Whereas by an act of Congress of the United States of America entitled "An act making further provision for the establishment of an armory and arsenal of construction, deposit, and repair on Rock Island, in the State of Illinois," approved June 27, 1866, it is enacted as follows, viz:

"That the Secretary of War be, and is hereby, authorized and directed to change, fix, and establish the position of the railroad across Rock Island, and the bridge across the Mississippi River at and on the island of Rock Island, so as best to accord with the purposes of the Government in its occupancy of said island for military purposes; and in order to effect this he is authorized to grant to the railroad company a permanent location and right of way on and across Rock Island, to be fixed and designated by him, with such quantity of land, to be occupied and held by the company for railroad purposes, as may be necessary therefor, and that the said grant and change be made on such terms and conditions previously arranged between the Secretary of War and the companies and parties in interest, as will best effect and secure the purposes of the Government in occupying the island.

"2nd. That the Secretary of War be, and is hereby, authorized to grant to the companies and parties in interest such other aid, pecuniary or otherwise, towards effecting the change in the present location of their road and bridge, and establishing thereon a wagon-road, for the use of the Government of the United States, to connect said island with the cities of Davenport and Rock Island, to be so constructed as not materially to interfere with, obstruct, or impair the navigation of the Mississippi River, as may be adjudged to be fair and equitable by the board of commissioners, authorized under the act of April 19, 1864, entitled 'An act in addition to an act for the establishment of certain arsenals,' and may be approved by him;"

And whereas said board of commissioners, in a report upon the matter of the railroad and bridge across Rock Island and the Mississippi River, under the date of February 2, 1867, adopted and recommended the following propositions as to the kind of wagon road that should be established, and the amount and kind of aid that should fairly and equitably be granted by the Government towards effecting that object, to wit:

"The Government to build over the main channel of the river an iron draw-bridge, in accordance with the conditions prescribed in the act of Congress of July 25, 1866; the frame to be of proper breadth for a double track; the wagon-way to be planted high enough to leave the lower chord for a railroad-track. The Government to give the company the right of way over this bridge and across the island, upon the payment of half the cost of the superstructure of the bridge, the bridge to be built with due regard to economy, having reference to strength and durability. The company to have five years from January 1st, 1867, in which to connect with the new bridge, and to remove its present track across the island and the old bridge and piers from the main channel. The company to open wagon-ways for the use of Government through their present embankment on the island, and remove, as far as practicable, present obstructions to wagon trade between the island and city of Rock Island; the Government to have the right to connect with the track of the company such side tracks as may be desired for the United States, and at such points as the Ordnance Department may select."

And whereas the Chief of Ordnance, Brevet Major-General A. B. Dyer, in a report to the Secretary of War, dated February 8, 1867, approved the foregoing recommendations of the said board of commissioners respecting the location of the railroad across the island and the bridge across the Mississippi River, the granting of a permanent right of way across the island, and the kind and character of the bridge to be erected; which report, location, so approved by the Chief of Ordnance and adopted by him, is understood and hereby taken to be the recommendation of that officer to which reference is made in the first section of the act of Congress of March 2, 1867, hereinafter mentioned;

And whereas by the first section of the act of Congress entitled "An act making appropriations for the support of the Army for the year ending June 30, 1868, and for other purposes," approved March 2, 1867, there is appropriated "for the erection of a bridge at Rock Island, Illinois, as recommended by the Chief of Ordnance, two hundred thousand dollars: Provided, That the ownership of said bridge shall be and remain in the United States, and the Rock Island and Pacific Railroad Company shall have the right of way over said bridge for the purposes of transit across the island and river,

upon the condition that the said company shall, before any money is expended by the Government, agree to pay, and shall secure to the United States, first, half the cost of said bridge; and, second, half the expenses of keeping said bridge in repair; and upon guaranteeing said conditions to the satisfaction of the Secretary of War, by contract or otherwise, the said company shall have the free use of said bridge for purposes of transit, but without any claim to ownership thereof;"

And whereas by a joint resolution of the Congress of the United States "in relation to the Rock Island bridge," approved July 20, A. D. 1868, it was provided as follows:

"*Be it resolved by the Senate and House of Representatives of the United States in Congress assembled*, That the act of Congress making appropriations for the support of the Army for the year ending June 30, 1868, and for other purposes, approved March 2, 1867, be, and the same is hereby, so amended as to authorize and direct the Secretary of War to order the commencement of the work on the bridge over the Mississippi River at Rock Island, to connect the said island with the cities of Davenport and Rock Island: *Provided*, That the ownership of said bridge shall be and remain in the United States; and the Rock Island and Pacific Railroad Company shall have the right of way over said bridge for all purposes of transit across the island and river, upon condition that the said railroad company shall pay to the United States: first, half of the cost of the superstructure of the bridge over the main channel, and half the cost of keeping the same in repair, and shall also build at its own cost the bridge over that part of the river which is on the east side of the island of Rock Island, and also the railroad on and across said island of Rock Island; and upon a full compliance with these conditions said railroad company shall have the use of said bridge for the purposes of free transit, but without any claim to the ownership thereof; and said railroad company shall within six months after said new bridge is ready for use remove their old bridge from the river and their railroad-track from its present location on the island of Rock Island: *And provided further*, That the agreement may permit any other road or roads wishing to cross on said bridge to do so by paying to the parties then in interest the proportionate cost of said bridge and securing to be paid its proportionate cost of keeping the same in repair, but no such permission to other roads shall impair the right hereby granted to the Chicago, Rock Island and Pacific Railroad Company, and the total cost of said bridge shall not exceed the estimate made by the commissioners appointed under the act approved June twenty-seven, eighteen hundred and sixty-six: *And provided also*, That in no case shall the expenditure on the part of the United States exceed one million dollars.

"SEC. 2. *And be it further resolved*, That in case the Rock Island and Pacific Railroad Company shall neglect or fail for sixty days after the passage of this resolution to make and guarantee the agreement specified in the act of appropriation aforesaid, approved March second, eighteen hundred and sixty-seven, then the Secretary of War is hereby authorized and required to direct the removal of the existing bridge and to direct the construction of the bridge aforesaid, and expend the money appropriated in said act; and the said Rock Island and Pacific Railroad Company shall not have, acquire, or enjoy any right of way or privilege thereon, or the use of said bridge, until the agreement aforesaid shall be made and guaranteed according to the terms and conditions of said act of appropriation. All acts or parts of acts inconsistent with these resolutions are hereby repealed.

"SEC. 3. *And be it further resolved*, That any bridge built under the provisions of this resolution shall be constructed so as to conform to the requirements of section two of an act entitled 'An act to authorize the construction of certain bridges and establish them as post-roads,' approved July twenty-fifth, eighteen hundred and sixty-six:"

Now, therefore, for the purpose of carrying into full effect the provisions of the several laws aforesaid, and for the considerations hereinafter set forth, the Chicago, Rock Island and Pacific Railroad Company, by John F. Tracy, its president, who is duly authorized and empowered by the said company to bind the same hereunto, hereby covenants and agrees with the United States of America, hereinafter represented in this behalf by John M. Schofield, Secretary of War, as follows:

First. The said company will, at its own expense, relocate its railroad-track across the island of Rock Island, upon such line as may be there designated by the Secretary of War in pursuance of the act of June 27, 1866, above cited; and the Secretary of War shall grant to said company, upon the line so designated, a permanent location and right of way, of a width to be fixed by him, with such quantity of land to be occupied and held by the company for railroad purposes as may be necessary for the convenient construction of its track and the passage of its trains; which grant shall not authorize the company to erect any structures upon the land so granted except the railroad-tracks necessary for its business, nor to use said land for other purposes than the construction and keeping in repair of its necessary tracks and the passage of its trains; and the United States shall have the right to connect with the track of the company upon said island such side tracks as may be desired for the use of the United States, and at such point on said island as the Ordnance Department may select.

Second. Said company will, at its own cost, construct that part of the bridge to connect the island with the cities of Davenport and Rock Island, which is on the east side of the island; to be of such character and to be built in such manner as shall be agreed upon between the said company and the Secretary of War, the same to be completed as soon as that portion of said bridge on west side of the island is completed.

Third. The company shall, on the first day of January, A. D. 1872, pay to the Government of the United States one-half the cost of the superstructure of that portion of said bridge which is to be built by the Government of the United States over the main channel of said river: *Provided*, That the aggregate cost of the said bridge shall not exceed twelve hundred and ninety-six thousand two hundred and ninety-two dollars and eleven cents, the estimate of the same made by the commissioners appointed under the act approved June 27, 1866: *And provided further*, That the said bridge shall be completed in such manner as to afford a safe and proper crossing for the railroad-trains of said company, and in such manner that the railroad of said company can be connected therewith by suitable and practicable embankments, before the money stipulated to be paid herein by said company to the United States shall become due and payable: *And provided further*, That the said bridge shall be built upon a plan to be agreed upon between the said company and the Secretary of War; or, in case of failure to make such agreement, the point in controversy shall be finally determined by one competent engineer, to be appointed by the Secretary of War, and one to be appointed by the said company, these two to choose a third, in case of their disagreement, to act as umpire.

Fourth. The United States are to keep said bridge in repair, and the said company agrees to forever pay one-half of the cost thereof, from time to time, as the same shall accrue; but the sleepers and rails are to be put down upon the bridge and kept in repair at the expense of the railroad company, without cost to the United States, who will make all repairs to the wagon-road without cost to the company.

Fifth. The said company agrees to relocate the track across said island and to remove its present bridge across the main channel of said river west of said island within six months after the completion of the said new bridge ready for use.

In witness whereof, these presents are signed by the Secretary of War, on behalf of the United States, and by John F. Tracy, president of the Chicago, Rock Island and Pacific Railroad Company, he being thereto lawfully authorized, and the seal of said company being hereunto affixed.

[SEAL OF THE WAR DEPARTMENT, U. S.]
{ SEAL OF THE CHICAGO, ROCK ISLAND }
{ AND PACIFIC RAILROAD CO. }

J. M. SCHOFIELD.
JOHN F. TRCY,
President Chicago, Rock Island and Pacific R. R. Co.

Attest:
EBENEZER COOK,
Secretary of C., R. I. & P. R. R. Co.

An act of Congress approved March 3, 1869, appropriated $500,000 for the construction of the bridge.

During the year 1869 General Rodman made careful surveys of the bed of the river, measurements of the velocity of the current at different stages of the water, and determined upon the sites for the abutments and piers, and on the 9th of June, 1869, made a contract with Messrs. Harvey & Livesey for the construction of the masonry piers.*

On the 18th of March General Rodman wrote to the Chief of Ordnance and requested that the money appropriated for the bridge ($700,000) be placed at his disposal, and that advertising for proposals for materials, &c., to construct the bridge, be dispensed with, and that circular-letters be addressed to the principal bridge-dealers instead. This request was made in order to save the time that would be consumed in advertising, which would perhaps prevent the completion of the bridge during the season. He also requested authority to employ a competent bridge-engineer.

This letter was laid before the Secretary of War, who approved of all the requests made, except that with reference to omitting to advertise for proposals.

* This contract, record of surveys, and all drawings and papers relating to the bridge were turned over to the Engineer Department by General Rodman in July, 1869, in obedience to an order of the Secretary of War, and have not been returned. I cannot, therefore, give a full account of the work done to prepare for the construction of the bridge before the work was turned over to the Engineer Department.

By referring back to the report of the board of commissioners and the acts of Congress based upon the same, it will be seen that they contemplate the construction of a bridge wide enough for a double-track railway, and the placing of the wagon-road above the railroad, and limit positively the total cost of the bridge (including the share to be paid by the railroad company) to one million dollars.

General Rodman found, subsequently, that the bridge could not be built as proposed with the amount of money specified, and recommended a change of plan.

This led to a good deal of correspondence with the Chief of Ordnance and the Secretary of War, and as it is believed that this was partially, if not wholly, the cause of the transfer of the bridge construction to the Engineer Department subsequently, much of this correspondence will be given here. General Rodman wrote to the Chief of Ordnance on this subject on May 26, 1869, as follows:

ROCK ISLAND ARSENAL,
May 26, 1869.

SIR: The commissioners appointed under the acts of Congress, approved April 19, 1864, and June 27, 1866, recommended the Government to built over the main channel of the river an iron draw-bridge, in accordance with the condition prescribed in the act of Congress of July 25, 1866, the frame to be of proper breadth for a double track, the wagon-way to be placed high enough to leave the lower chord free for a railroad-track.

The Chief of Ordnance, in his letter to the Secretary of War, dated February 8, 1867, approved the recommendations of the commissioners as to the kind and character of the bridge. The act of Congress approved March 2, 1867, appropriated $200,000 for the erection of a bridge at Rock Island, Illinois, as recommended by the Chief of Ordnance.

The joint resolution of Congress approved July 20, 1868, contains the following proviso: "*And provided also*, That in no case shall the expenditure on the part of the United States exceed one million dollars."

This resolution also cites, among other things to be done by the Chicago, Rock Island and Pacific Railroad Co., to entitle them to the right of way or transit over said bridge, that said company shall pay to the United States half of the cost of the superstructure of the bridge over the main channel, and one-half the cost of keeping the same in repair.

Now, I am in doubt as to whether the proviso above cited means that the outlay of money by the United States, in the construction of said bridge, shall not exceed one million dollars, or that the cost of said bridge to the United States, after said company shall have paid to them half of the cost of the superstructure as cited, shall not exceed one million dollars.

If the first of these constructions be placed upon this proviso, it will exclude, for want of funds, the possibility of constructing the bridge wide enough for a double railroad-track, (see sheet of estimates herewith inclosed,) as recommended by the commissioners; nor do I think it would be a judicious expenditure of public money to build such a bridge, even if we had the funds at our disposal.

The sheet of estimates, above referred to, compares the relative cost of a bridge and wagon-road approaches with single tracks for railroad and wagon-road above railroad, with the same bridge, except that the wagon-road is below the railroad and the approaches adapted thereto. Sheets Nos. 1 and 2 of drawings, sent by this day's mail, show the method of approach to the wagon-road at the island end of the bridge, the Davenport end being of the same character, but with about eleven feet higher sustaining walls and embankments. Plan No. 1 shows approach to wagon-road above railroad, and plan No. 2 to wagon-road below railroad.

It will be seen that these estimates make the net cost to the United States of the bridge with wagon-road below railroad, $43,794 less than when the wagon-road is placed above the railroad, the United States having to construct their own approaches to wagon-road, and the Chicago, Rock Island and Pacific Railroad Co. to construct only the approaches for railroad.

The wagon-road below railroad, besides being cheaper, will be much more sightly and incomparably more convenient in itself, and will also enable us to pass under railroad-track with wagon road to Rock Island City, and thus avoid crossing main track of railroad on the island, which I regard as a very important consideration.

The laws above cited, if strictly construed, require that the wagon-road should be above the railroad, and the railroad co'y, under that construction, would have a just claim against the United States for the cost to that company of placing their railroad

above the wagon-road, in excess of what it would cost them to place it *under* the wagon-road, should the United States require them to do so.

For the foregoing reasons I have deemed it proper, before commencing work on either of the three plans of bridge, to lay the facts in the case before the proper authority, and to ask for early instructions as to which plan shall be adopted. My own judgment is that the plan with single track for railroad, and with wagon-road below railroad, is the one that should be adopted.

I should also state that the railroad co'y, through their chief engineer, have expressed their willingness to place the railroad above the wagon-road, provided they are paid the actual extra cost of so doing.

T. J. RODMAN,
Lt. Col. Ordn., Bvt. Brig. Gen'l.

Bvt. Major-Gen'l A. B. DYER,
Chief of Ordnance.

The following are the abstracts of the estimates referred to in the foregoing letter:

Estimates made by Lt. W. P. Butler.

For a double-track R. R. bridge with wagon-road *above* R. R	$1,234,525 00
Less ⅓ cost of superstructure	400,000 00
Net cost to the U. S	834,525 00
For a single-track R. R. bridge with wagon-road *above* R. R	978,085 00
Less ⅓ cost of superstructure	300,000 00
Net cost to the U. S	678,085 00
* For a single-track R. R. bridge with wagon-road *below* R. R	934,291 00
Less ⅓ cost of superstructure	300,000 00
Net cost to the U. S	634,291 00

The rest of the correspondence on this subject is copied in regular order, without remarks, as follows:

[Telegram.]

Chief of Ordnance to General Rodman.

JUNE 10, 1869.

Secretary of War directs that bridge must be built according to the plan recommended by Chief of Ordnance, Feb'y 8, 1867; total cost of bridge not to exceed one million dollars. If it cannot be constructed for this sum, the fact must be reported at once.

ORDNANCE OFFICE,
Washington, June 10, 1869.

Bvt. Gen'l T. J. RODMAN,
Com'dg Rock Island Arsenal:

SIR: Your letter of 26th ulto., on subject of railroad-bridge, was submitted to the Secretary of War, with the following indorsement:

"The recommendations of Bvt. Br. Gen'l Rodman are concurred in by this bureau, and their approval by the Secretary of War is recommended, if warranted by law.

"The reference of the subject to the Attorney-General, for his opinion as to the proper construction of the acts of Congress, referred to by Bv. Br. Gen'l Rodman, is earnestly requested.

"An immediate decision of the question is very important."

The Secretary referred the question to both the Judge-Advocate-General and the Attorney-General, (copies of whose opinions are transmitted herewith.) Upon the receipt of these opinions the Secretary of War returned the papers to this office with the following instructions indorsed thereon:

"Respectfully returned, by order of the Secretary of War, to the Chief of Ordnance, inviting attention to the accompanying opinion of the Judge-Advocate-General, concurred in by the Hon. Attorney-General, from which it appears that the bridge must

* The bridge was finally built with the change of plan, as recommended by Gen'l Rodman, and cost about $65,000 more than this estimate.

be built according to the plan recommended by the Chief of Ordnance on the 8th February, 1867, and that the total cost of such bridge must not exceed one million dollars, irrespective of any amount which may be re-imbursed to the U. S. by any railroad company for the right of way over said bridge, as provided by law.

"If it be impracticable to construct the prescribed bridge for the sum named, immediate report of the fact will be made to the Secretary of War.

"E. D. TOWNSEND,
"Adj't Gen'l."

All of which information is communicated for your government in the premises.

Respectfully, your obed't serv't,
By order:
T. J. TREADWELL,
Br. Lt. Col. & Maj. Ordn.

WAR DEPARTMENT,
BUREAU OF MILITARY JUSTICE,
Washington, D. C., June 4, 1869.

Respectfully returned to the Secretary of War.

The two material questions which appear to me to be raised by the accompanying communication of Gen'l Rodman to the Chief of Ordnance are—

1st. Whether the military authorities are at liberty to depart, in the construction of the bridge, from the plan prescribed in the statute on the subject of March 2, 1867.

2d. Whether Congress, in providing, by the joint resolution of July 20, 1868, that in no case the expenditure on the part of the United States shall exceed one million dollars, meant (to cite the language of Gen'l Rodman) "that the outlay of money by the United States in the *construction* of said bridge shall not exceed one million dollars," or that the cost of said bridge to the United States, after "the railroad company" shall have paid to them "half the cost of the superstructure," (required by the same resolution to be paid by the company in order to entitle them to the right of way and transit) "shall not exceed one million dollars."

1st. As to the first question, I am very clear that the executive department of the Government has no authority whatever to depart from the plan for the bridge established by the statute. This plan was that recommended by the Chief of Ordnance in the terms set forth in the letter of Gen'l Rodman. In formally adopting this recommendation and appropriating a specific sum for the erection as recommended, Congress, which alone was empowered to authorize such erection at all, has prescribed conditions which the department or officers charged with the work can clearly have no right or privilege to depart from. These conditions are the expenditure of no more than the stated appropriation, and a compliance with the prescribed plan in the construction, and without further authority from Congress itself no additional public funds can be laid out upon the work, nor can the plan be modified in any essential particular.

2. As to the second question, I am equally clear that it was the intention of Congress to provide that the sum of one million dollars should be the absolute limit of the entire expenditure on the part of the Government, without reference to the amount required to be paid, and which might thereafter be paid by the company as a consideration for the grant of the right of way. Under the present legislation, therefore, no estimate of the work can, in my opinion, properly be made and acted upon, which contemplates in any event a greater total outlay. But, it seems to me, at the same time, that the question of the construction of the joint resolution is one which the military officers of the Government are not called upon to determine at this period. These officers, under the interpretation which I have given to the act of 1867, are confined to a certain work, according to a prescribed plan, and are empowered in that work to expend, for the time being, a certain sum. Thus limited, they can have no occasion to decide upon the proper meaning of a statute which concerns in no manner the work as at present marked out. By fixing the expenditure for the completed structure at one million dollars, Congress has restricted itself and future Congresses to appropriations which shall not exceed this total; and while this restriction may of course be removed by future legislation, the consideration of this question by the executive branch of the Government would appear to be at this time premature; the subject being altogether outside of its present province, which is to proceed with the work according to the plan prescribed and with reference to the appropriation authorized.

There is indeed a further question raised by the papers, upon which, however, this bureau would not be competent to report. From the inclosed estimates, it would appear to be the opinion of the officers charged with the work, that if the plan should be departed from in a certain essential particular there would be saved to the Government a large sum. Whether, in view of this very considerable saving, the Secretary of War will deem it proper to suspend the work altogether until Congress shall authorize the proposed modification, is a matter which must remain within his discretion, and upon which I do not feel called upon or qualified to advise.

J. HOLT,
Judge-Advocate-General.

ATTORNEY-GENERAL'S OFFICE,
Washington, June 9, 1869.

SIR: Your letter of June 9, 1869, asking my opinion in regard to the construction of the acts of Congress providing for the erection of a bridge at Rock Island, Illinois, and inclosing the opinion of the Judge-Advocate-General, dated June 4, 1869, is received at this office.

Without stating in detail the reasons upon which my opinion is founded, I will merely say that I concur substantially in the opinion given by the Judge-Advocate General. I do not think there is any authority in law for your Department to proceed with the erection of any other bridge than the one "recommended by the Chief of Ordnance," referred to in the act of March 2, 1867. Nor do I think that Congress ever authorized the expenditure by the United States for the bridge of more than one million dollars, without reference to the amount to be refunded by the railroad company.

Very respectfully, your obed't serv't,

E. R. HOAR,
Attorney-General.

Hon. JOHN A. RAWLINS,
Secretary of War.

The opinion of the Judge-Advocate-General, transmitted with your letter, is herewith returned.

[Telegram.]

General Rodman to Chief of Ordnance, date June 11, 1869.

Acknowledges receipt of telegram of 10th inst. States that a bridge wide enough for a double track, and high enough for a wagon-road above, cannot be completed for one million dollars. Refers to his letter of May 26, and accompanying estimate.

[Telegram.]

Chief of Ordnance to General Rodman, date June 11, 1869.

Wishes to know upon what basis are calculations made; and if they cannot be reduced so as to come within the law.

[Telegram.]

General Rodman to Chief of Ordnance, date June 11, 1869.

Estimate is based upon calculations, and I think it cannot be reduced.
The wagon-road ought, by all means, to be below railroad.

General Rodman, in a letter to the Chief of Ordnance, dated June 15, 1869, wrote as follows:

Without calling in question the soundness of the opinion of these learned gentlemen, (the Judge-Advocate-General and Attorney-General,) it is clear to my mind, from all legislation that has been had on the subject, that Congress *intended* that a rail and wagon road bridge should be constructed across the Mississippi River at this point. Congress could not, therefore, have intentionally prescribed the kind and character of the bridge, and then limited its cost to a sum that would not build it; and since the sum to which the cost of the bridge has been limited will build a single-track bridge, with the wagon-road below, and such a bridge will better promote the public interest than the one prescribed, it appears to me that the Executive could hardly be charged with a violation of law in adopting a construction which would, under the several acts of Congress on the subject, be practicable, instead of being a nullity. I simply suggest this for your consideration, and respectfully request your further and early instruction.

Contracts for stone have been made and stone is being delivered, but piers and abutments cannot be built until the kind of bridge that is to rest upon them is known.

[Telegram.]

Chief of Ordnance to General Rodman, date June 18, 1869.

No departure from recommendation of commissioners as to character of bridge allowable without authority of Congress.

[Telegram.]

Secretary of War to Chief of Ordnance, date June 29, 1869.

Bridge must be built according to plans submitted to Congress by the commissioners; cost not to exceed one million dollars.

[Telegram.]

General Rodman to Chief of Ordnance, date June 30, 1869.

Shall proceed to construct the piers of proper dimensions for a double-track bridge, unless otherwise ordered.

Chief of Ordnance to General Rodman, date July 9, 1869.

Incloses copy of order from the Secretary of War, transferring the construction of the bridge from the Ordnance to the Engineer Department.

In obedience to the foregoing order, all drawings, surveys, plans, contracts, and other papers relating to the construction of the bridge were at once turned over to Major G. K. Warren, Engineer Department, (Brevet Major-General, U. S. A.)

General Rodman had bestowed a great deal of time, labor, and trouble upon the work of procuring the construction of the bridge, and it had presented many difficulties and great obstacles to be overcome from the first.

The history of the bridge matter has shown that a powerful railroad company had acquired with much trouble a right of way across the island, had built with great expense their bridges to the island, and embankment and roadway across the island, and had the whole in successful and remunerative operation. It was no easy task to get this company to consent to bear the expense of tearing up and removing all of this construction, to incur the cost of building a new line of road across the island, to pay part of the cost of the new bridges, and relocate its tracks through the city of Davenport, involving the cost of a new right of way, heavy embankments, new depot-buildings, and bridges over streets. The work had to be accomplished through the instrumentality and by the power of Congress, and it is not easy to obtain through Congress the successful accomplishment of a work harassed and pulled different ways by so many conflicting interests as operated in this case, particularly when it involved the procurement of an appropriation for so large a sum of money (one million dollars) as this work required. Persons of influence interested in the building of the arsenal, while they admitted freely the desirableness and importance of building the bridge and relocating the railroad, deemed it simply impossible that it could be consummated. This had all been accomplished, and mainly through the persistence, ability, and hard work of General Rodman. The plans for the work were completed, and only the pleasant task of building the bridge was left to be done. General Rodman was deeply interested and took great pride in the work, and its transfer to other officers was a serious blow to him. I believe it has never been supposed by any one that the Engineer Department was instrumental in procuring the transfer.

In October, 1869, General Warren made a report to the Chief of Engineers, stating the kind of bridge he proposed to build, the location of the draw and other piers, and located the draw at the island edge of the bridge. This was contrary to the original plan, which located the draw over the channel near the middle of the river.

General Rodman wrote to the Chief of Ordnance on the subject, as follows:

ROCK ISLAND ARSENAL, *Nov'r 3, 1869.*

Brig. Gen'l A. B. DYER,
Chief of Ordnance, Washington, D. C.:

SIR: I have the honor to inclose herewith a copy of a map showing the location, &c., of rail and wagon road bridge between Rock Island and the city of Davenport, and of an extract from the report of General G. K. Warren relative to said bridge, both of which were kindly furnished me by General Warren.

You will see by reference to these papers that General Warren has not changed

the location or position of the bridge as selected by me. He has shortened the bridge, as stated in his report, but at the expense of the water-way at high water, where it is most needed; however, his calculations, comparing the water-ways of the old and new bridges, indicate that the new bridge will diminish the obstruction to navigation offered by the old one in this respect, though not to the same extent that the location of the north abutment, as proposed by me, would have done. It will also be seen that General Warren locates the draw-pier so that one end of the draw, when closed, will rest upon the island abutment. I had intended to place one span of not less than 250 feet between the island shore and the draw, and another span of the same length contiguous to the other end of the draw, and thus comply with the second section of the act of July 25, 1866, relative to the construction of bridges, and better secure the seclusion of the island, and better adapt it to the purpose for which it has been set apart. General Warren correctly states my objections to locating the draw contiguous to the island shore; but he does not seem to attach to them the weight and importance to which, in my judgment, they are entitled. The bay, just above the site of the island end of the proposed bridge, is the only suitable site for a wharf or steamboat landing on the lower half of the island. The extreme lower end of the island, the point referred to by General Warren as a suitable site, is, in my judgment, entirely unsuitable for a landing; the shore at this point being an almost vertical ledge of rocks, and from ten to twelve feet above high water, and a sand-bar, which is bare at stages of water some feet above low water, lies just below it, and the embankment on which the railroad track will cross the island will be about 12 feet high, and run parallel with the shore and fifty to one hundred feet from it, and between it and the receiving and issuing store-house, thus cutting off access to this shore, except at its two extremities.

Now, suppose the arsenal and armory completed, and in full operation in time of war; there may be lying at this wharf, in the bay above referred to, receiving and discharging Government freight, anywhere from one to ten steamboats, which will certainly interfere with the passage of boats between the draw-pier and the island shore, and thus leave practically but one passage through the draw. Again, with the boats receiving and discharging freight as above, suppose a steamer attempting to drop down through the draw by attaching a line to the island shore above them, it could not but interfere with their operations and give rise to trouble; and in the absence of all boats from the wharf, to have passing boats land upon the island such characters as are generally found among boats' crews, and whom it would be necessary to put ashore in dropping down through the draw as above described, would be liable to originate trouble between them and the island guard, and, in great measure, to destroy that seclusion so necessary for an arsenal and an armory, and on account of which seclusion, to a great extent, the island was selected and set apart for its present uses. Besides it would be an easy matter to accomplish the dropping down of boats, as above described, by building a pier at a proper distance above the new bridge, and between the channel of the river and the island shore, with facilities for attaching boats by lines thereto. These reasons are to my mind conclusive that there should be one span at least of the bridge between the island and the island end of the draw.

General Warren names three positions for side or foot-passenger ways on the bridge: one on upper chord and one on lower chord, but inside of trusses, and one on lower chord and outside of trusses. The first of these is to my mind the worst, and would, in midsummer and in winter, from the necessity of ascending and descending a flight of stairs 33 feet high, that may be covered with snow or ice, and the liability to encounter the steam, smoke, and cinders from passing locomotives below, be so inconvenient, dangerous, and uncomfortable, as to render it virtually useless, except in case of necessity.

Of the other two, the one outside the trusses is decidedly the best, and should be adopted, and the sidewalks made not less than six feet wide. Nor do I think the roadway should be less than twenty feet in the clear. My idea has been, and still is, that the objects which the Government had in view in building this bridge were, 1st, to better adapt Rock Island to the purpose for which it has been set apart, and, 2d, to remove, as far as practicable and compatible with this first-named object, the obstructions offered to navigation by the old railroad-bridge at this place. Nor do I think that either of these objects should be lost sight of or abandoned in the construction of this bridge for the sake of saving a few thousand dollars. If it is worth doing at all it is worth doing properly.

I have written this paper not for the purpose of criticism or finding fault with General Warren's plans, for he has been most courteous towards me, and our relations are most friendly, but because I am in charge of ordnance interests here, and feel it to be my duty to give the Government the benefit of my views on this subject, should they be deemed worthy of consideration.

Very respectfully,

T. J. RODMAN,
Lt. Col. Ordn., Comd'g.

This letter was referred to the Secretary of War by the Chief of Ordnance, with the following indorsement:

Respectfully submitted to the Secretary of War, whose attention is invited to the views and suggestions given by General Rodman, whose long and careful study of the question of so locating the bridge as best to promote the objects contemplated and expressed by Congress in the acts approved April 19, 1864, and June 27, 1866, is worthy of careful consideration. The act of April 19, 1864, authorizes the Secretary of War to take and hold full and complete possession, on behalf of the United States, of all the land and shores of the island of Rock Island, to be held and kept as a military reservation by the War Department, upon which shall be built and maintained an arsenal for the construction, deposit, and repair of arms and munitions of war, and such other military establishments as have been, or may be, authorized by law to be placed thereon, in connection with such arsenal. The act of June 27, 1866, authorizes the Secretary of War to change, fix, and establish the position of the railroad-bridge across the Mississippi River, so as best to accord with the purpose of the Government in its occupancy of said island for military purposes.

It is very clear that the intention of Congress was that the bridge should be so located as best to promote the interests of the Ordnance Department, and any location which would affect injuriously those interests, unless absolutely necessary, would be contrary to the intentions expressed by Congress.

This letter was returned to the Chief of Ordnance with the following indorsement by the Secretary of War:

The Secretary of War does not concur in the views expressed herein.

The position of the draw as fixed requires vessels going down stream to make rather a sharp turn around a point of the island shore above in order to enter the draw opening, and some accidents have occurred from vessels striking the draw-pier and rocky shore of the island. This defect may be partially overcome by the constructions to be placed above the piers for that purpose, under an act of Congress passed during its present session, as follows:

AN ACT making appropriations for sundry civil expenses of the Government, for the fiscal year ending June thirtieth, eighteen hundred and seventy-eight, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated for the objects hereinafter expressed, for the fiscal year ending June thirtieth, eighteen hundred and seventy-eight, namely:

* * * * * * *

To protect the piers at the draw of the bridge across the Mississippi River at Rock Island, Illinois, owned by the United States, by the erection of booms, to be expended under the direction of the Secretary of War, fifteen thousand dollars, and the Chicago, Rock Island and Pacific Railway Company is required to refund to the Treasury of the United States one-half the said sum, and the Secretary of the Treasury is hereby directed to enforce this condition.

* * * * * * *

Approved March 3, 1877.

The following resolution of Congress was subsequently passed, and approved March 25, 1870:

PUBLIC RESOLUTION No. 29.

JOINT RESOLUTION in relation to the construction of the Rock Island bridge.

Be it resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That, in the construction of the bridge heretofore authorized by Congress, across the Mississippi River, between Rock Island and the city of Davenport, the Secretary of War shall have power to construct the same for a single-track railroad only, and to place the wagon-road below the railroad track, as recommended by the Chief of Engineers: *Provided*, That in no case shall the expenditure on the part of the United States exceed one million dollars.

It is not deemed expedient or necessary to give a history of the construction of the bridge while in charge of the Engineer Department. Full reports on the subject have been made to the Chief of Engineers in

the annual reports of the officer in charge of the work, and have been published in the annual reports of the Chief of Engineers.

As stated heretofore, the work of construction was turned over to the Engineer Department in July, 1869. The bridge was not completed and turned over to the commanding officer of the arsenal until February, 1873.

The bridge is constructed as follows, (see map on plate VI:)

DESCRIPTION OF THE BRIDGE.

The total length of the bridge is 1,550 feet and 6 inches, divided into five spans and one draw, as follows: Beginning at the north end, the first span is 260 feet long; the second, third, and fourth are each 220 feet long; the fifth, 260 feet and 6 inches long; and the total length of the draw is 368 feet. There is also a shore span at each end to carry the railroad over the approaches to the wagon-road. The span at the north or Davenport end is 197 feet long, and the one at the south or island end is 100 feet and 8 inches long, making the total length of the bridge, including the shore spans, 1,848 feet and 2 inches.

The draw is double, rests on a center pier, and gives, when open, clear water-ways between the draw-pier and the adjacent north pier on one side and the draw-pier and south abutment on the other side of 162 feet each. The draw-rests for the ends of the draw when open are of masonry, and the spaces between these and the draw-pier are filled with timber cribs.

The plan dimensions of the piers (except the draw-pier) are at the top, each 7 feet wide by 43 feet 6 inches long, and at the bottom the widths range from 10 feet to 13 feet 6 inches, and the lengths from 65 feet to 70 feet. The down-stream ends of the piers are circular, and the up-stream ends have sharpened, sloping cut-waters covered with boiler-plate iron. The heights of the piers from the foundations range from 25 feet to 45 feet. The clear height of the bridge above high water is 13 feet 6 inches.*

The superstructure of the main bridge is a double-system Whipple truss, with vertical main posts, and has two decks.

The wagon-road is on the lower and the railroad on the upper deck. The clear height between the wagon-road and the upper deck is 12 feet and 6 inches, and the clear height between the rails of the railroad and the top bracing is 17 feet. The total height of the truss from the top of piers to the top bracing is 37 feet and 2 inches. The width from center to center of the side chords is 19 feet and 6 inches, and the clear width of the wagon-way is 16 feet and 4 inches. The footwalks are outside of the side chords. The wrought-iron Phœnix column is used for the posts and top chords, and flat iron bars for ties. The upper or railroad deck is constructed as follows: Fifteen-inch wrought-iron I-beams cross from

* The high water referred to here is natural high water. The river at this point is subject to ice gorges when the ice is breaking up in the spring, and at such times the river may rise several feet above natural high water; at such times the unusual height is not maintained many hours—very rarely as long as twenty-four hours. Then the gorge breaks or partially gives way and the river falls to or toward its natural level. These gorges are formed and broken generally many times in each season, and sometimes two or three times in one day. The conformation of the river below the bridge is favorable for the formation of gorges, and the consequent rise and fall of the river usually occurs at the bridge. It is not sufficient to cause any apprehension for the safety of the bridge, but in one extreme case the river, or rather the ice on the river, rose to within a few feet of the bottom of the bridge, and considerable quantities of ice were pushed up on top of the piers.

post to post of the side chords and are riveted into the posts. Wooden stringers are suspended under these beams, and on these are laid 15-inch wooden beams or floor-joists, so that the wooden beams are contained between the same horizontal planes that contain the tops and bottoms of the iron beams.

The wooden joists for the lower deck rest on double-channel-bar stringers, which take the main piers of the bottom chord and are supported by them.

The shore spans to carry the railroad over the approaches of the bridge are the single-system Pratt truss.

The superstructure was erected by the Baltimore Bridge Company, and the iron-work was manufactured by the Phœnix Company. The draw is swung by two vertical hydraulic jacks operated by steam-power. On the upper end of the piston of each hydraulic cylinder is a pulley over which passes a wire rope, one end of which is fastened to the draw and the other to the draw-pier. A proper direction for the ropes, between their fastened ends and the top of the pistons, is maintained by these pulleys. One piston rises to open the draw and the other to close it, and each piston, when the other is moving the draw, is used to check and stop the motion when necessary. A full description of this machinery will be given in another chapter describing alterations that have been made in it.

The construction of the bridge was in charge of Col. John N. Macomb, United States Engineers, and his assistants. Capt. Amos Stickney supervised directly the construction of the masonry, and Capt. W. H. H. Benyaurd that of the superstructure.

The bridge is one of the strongest and best in the United States. Some minor defects in its construction are as follows:

The clear width of the roadway is rather limited for a double roadway. Wide loads of various kinds cannot be allowed on the bridge, and generally the width is not sufficient for ease and comfort in driving.

The floor-beams and stringers of the upper deck are of wood. When the wood decays the cost of tearing up to replace the beams will be considerable, and the disuse of the bridge during the considerable time required for the repairs will be a great inconvenience.

The machinery for operating the draw was insufficient in power, and the cover to shed water from the upper deck ineffective. These last two defects have been remedied. The history of the bridge from February, 1873, is taken up again in Chapter IX.

The acts of Congress relating to the Rock Island bridge, and the guarantee between the Chicago, Rock Island and Pacific Railroad Company and the United States, describe the Rock Island bridge to be "the bridge across the Mississippi River at and on the island of Rock Island," and also as the "bridge over the Mississippi River at Rock Island to connect the said island with the cities of Davenport and Rock Island," and require the railroad company to build, at its own expense, "that part of said bridge to connect the island with the cities of Davenport and Rock Island, which is on the east (south) side of the island," and the embankment on the island, (which bridge and embankment were for railroad uses only,) in accordance with plans to be approved by the Secretary of War.

I have no further information to show whether or not the plans for this work were ever submitted to the Secretary of War and acted upon by him, or by any officer of the Government. The object of requiring that the plans should be approved by the Secretary of War was to insure that the work should be so done as to conform, as far as possible, with

the other plans for the arsenal. It is not probable, therefore, that the plans would have been acted upon by the Secretary of War without being referred to the Chief of Ordnance and to the commanding officer of the arsenal for consideration, and they have not been so referred. I believe the railroad company proceeded with the work without referring the matter to the Secretary of War, and constructed this part of the bridge practically upon plans discussed verbally by the officers of the company and General Rodman, and considered satisfactory by them, in 1867. This work was completed and ready for use in 1872. As it is constructed, it is substantially as follows, (see map on Plate VI:) From the island or south end of the bridge over the main channel to where the Arsenal avenue, named Rock Island avenue on the map, crosses the line of the railroad, there is an earth embankment, generally about 13 feet high.

The track passes over Rock Island avenue on an iron bridge 80 feet long. From this bridge to the bridge over the south channel there is an earth embankment approach 700 feet long, and throughout most of its length it is in the river and 24 feet high. The iron bridge over the channel is 600 feet long, in four equal spans, and the earth embankment approach from the city of Rock Island to the south end of the bridge is 700 feet long. This embankment is also in the river and is 22 feet high.

CHAPTER VI.

THE ROCK ISLAND WATER-POWER UNDER GENERAL RODMAN'S COMMAND, 1865 TO 1871.

Ownership and early history of the Moline Water-Power—General Rodman reports to Chief of Ordnance injury to island resulting from Moline Water-Power Company's dam, deposits in slough, &c.—Letter from Moline Water-Power Company on same subject—Proposals made by Moline Company—Chief of Ordnance directs estimates to be made for cleaning out south channel—Estimates and plans for improving water-power—Moline Company decline to relinquish water-power and submit some plans—Act of Congress of June 27, 1866, making appropriations for water-power—Complaints of Moline Company—The Company unwilling to submit questions relating to water-power to a commission for arbitration—Premises occupied on the island by Moline Company ought to have been seized under act of April 19, 1864—Estimates of amount of water-power attainable and cost of same—Decision of Chief of Ordnance respecting water-power—Recommendations of Board of Commissioners respecting the water-power—Indorsement and approval of Chief of Ordnance on same—Joint resolution of Congress for carrying out recommendations of Commission—Difficulties encountered in making an agreement with the Moline Company—Complaints about expenditure of money ($40,000) on wing-dam—Agreement finally signed—Plans for developing water-power—Description of water-power—Correspondence about plans—Protests of land-owners against construction of wing-dam—Prosecution of work ordered by Secretary of War—Description of wing-dam—Construction of upper dam wall, history of—Appropriation act of June 8, 1868—Appropriation act of June 30, 1869—President of Moline Company states many years will be required to complete the water-power by the United States—Proposition to put in bulkhead—Letter from General Dyer on the subject—Change of plans for developing water-power projected—Correspondence on the subject—Correspondence submitted to Secretary of War—Further correspondence between Chief of Ordnance, General Rodman, and Moline Water-Power Company, and discussion of various matters relating to the water-power—Proposition from General Rodman to purchase the water-power for the United States—Moline Company offers to sell water-power for $160,000—1,600 inches of water to be reserved for Mr. Wheelock—Further correspondence on the subject—Letter from Moline Company to Secretary of War—Letter from General Rodman to Secretary of War—New agreement between Moline Company and United States, made April 9, 1869—Breaking away of old water-power dam and coffer-dams, September 29, 1869—Anxiety of Moline Company to have dams renewed at once—Railroad Company and other parties interested in the matter—New agreement made—

Coffer-dams put in and work resumed in November, 1869—Deposits removed from the pool—Lieutenant Shaler's report of soundings in the pool and measurements of flow of water into the pool—Remarks on same—Construction of water-power canal begun August, 1870—Moline Company prohibits prosecution of the work—Suspension of work authorized by Secretary of War—Work suspended and General Rodman makes report on the subject—Letter from and resolutions adopted by Moline Company—Give reasons for not permitting prosecution of the work—Moline Company consent to resumption of work August 19, 1870—New agreement made in September, 1870, (see Appendix D)—Description of water-power canal and methods employed in constructing the same—Remarks on same—Officers in charge of the work—Appendix A: Agreement between United States and Moline Water-Power Company, dated March 2, 1867—Appendix B: Agreement between same parties, dated April 8, 1869—Appendix C: Agreement between same parties, dated October 28, 1869—Appendix D: Agreement between same parties, dated September 7, 1870.

THE MOLINE WATER-POWER.

The following statement of the different owners and transfers of the Moline water-power, from the time it was first used in 1837 until the occupation of the island for military purposes by the Ordnance Department in 1863, and of the manner in which the present Moline Water-Power Company acquired the property, has been kindly furnished to me by Mr. Charles Atkinson, president of the company.

The charters referred to are not copied.

In February, 1837, the legislature of Illinois granted to David B. Sears and John W. Spencer a charter to build a dam across the slough to Rock Island. In February, 1839, this charter was extended. The dam was built in 1841 and 1842, and a saw and a grist mill were put up on the Moline side in 1842. The water-power was occupied by D. B. Sears and associates for several years. In 1851 it passed by sheriff's deed to Pitts, Gilbert & Pitts, of New York. About 1853 or 1854 Pitts, Gilbert & Pitts entered into contract with Charles Atkinson and others for the sale of the entire property, including water-power and mills. This arrangement was not carried out, and a suit followed, but it was ultimately settled by a compromise, and the contract was surrendered to Pitts, Gilbert & Pitts, together with a charter obtained by Charles Atkinson and associates, February 14, 1855. Pitts, Gilbert & Pitts then organized a company under this charter and carried on business for several years. The company issued a quantity of bonds to Hamilton White, of Syracuse, N. Y., in 1859, in order to raise money for improvements and repairs. These bonds were distributed to Horace K. White, jr., Charles Sedgwick, and several other parties in that city and vicinity. The bonds not being paid, the whole property, including water-power and franchises, subsequently came into possession of the bondholders, and finally a title by sheriff's deed was made to Horace K. White, jr., April 25, 1864, who held as trustee for himself and associates.

During the year 1864 negotiations were commenced by Charles Atkinson and associates for the purchase of the water-power and property adjoining, and in expectation that they would ultimately buy it, they (Atkinson and associates) in February, 1865, obtained the charter of the Moline Water-Power Company. In December, 1865, they organized a company under this charter, and the same date made purchase of the water-power and franchises and of land adjoining, and have occupied it since.

To show clearly the relations existing between the Moline Water-Power Company and the United States, it will be necessary to give in full a considerable part of the correspondence with that company and with the Chief of Ordnance on the subject prior to the meeting of the commission.

ROCK ISLAND ARSENAL,
November 7th, 1865.

Brig. General A. B. DYER,
Chief of Ordnance, Washington, D. C.:

SIR: I deem it my duty respectfully to call the attention of the Department to the present condition of the slough, or the minor channel of the river running between Rock Island and the Illinois shore.

Before any artificial obstructions were placed in this channel, a sufficient quantity of water passed through it to keep it free from deposits of sediment and give a healthy flow of water.

The following obstructions have been placed in this channel, viz: At the lower end the piers and embankment of the wagon-road bridge from the island to Rock Island City, and a short distance above it, those of the railroad-bridge; and at a point near the upper end of the island, a close dam, entirely across this channel, built by a water-power company, and so constructed as to allow no water to pass *over* it, and only so much *through* it as passes from leakage and that which is used as motive-power.

The effect of all these obstructions is to cause a sluggish flow of water in this channel, and deposits of sand, mud, sawdust, &c., above and below the bridges at the lower end of the island, and of sand and mud at the upper end, above the dam of the water-power company. These deposits have been gradually accumulating for a number of years, and already amount to a number of acres at each of the obstructions.

If these obstructions be allowed to remain as they now exist, this channel must ultimately, and, in my judgment, at no very distant day, become a pool of stagnant water, which cannot fail to affect seriously and injuriously the sanitary condition of this island.

The bridges are both necessary to the public interest here, and the water-way under them *may* be so increased as to offer no injurious obstruction to the flow of water.

The water-power derived from the water-power company's dam may, I think, if it can be preserved without injury to the sanitary condition of the island, be advantageously used, together with that derived from the dam between the main island and Benham's Island, as a motive-power for driving machinery in the public shops about to be erected on this island.

I should use the water-power to condense air to 50 or 60 lbs. per square inch, and convey this condensed air to the shops in iron pipes, and use it instead of steam, having steam-boilers for supplying steam to the same engine, when the water-power should, from any cause, fail to supply condensed air.

I inclose herewith, for the information of the Department, the views and propositions of the water-power company, and others interested in the preservation of that power, for preserving it without injury to the sanitary condition of the island.

It appears to me that early and definite action upon this subject should be taken by the Department at as early a day as practicable, as the deposits in the slough are, and will be, constantly accumulating.

I am, sir, &c.,

T. J. RODMAN,
Major of Ordnance.

MOLINE, ILL., *November 7th*, 1865.

Major T. J. RODMAN,
Rock Island Arsenal:

SIR: Having, by your kindness, been permitted to read your letter to the Department, of this date, referring to the dam at this place, and in pursuance of conversations with you in regard to the same, and its effect on the sanitary condition of the island and neighborhood, I am authorized, in behalf of those with whom these conferences have been had, to say:

First. That up to this time it is not realized that any special unhealthy influences have ever yet been experienced by the building of our dam; though we must agree with you that, should the dam and bridges continue as they now are, the deposits will naturally increase. Our own interest and comfort have long since suggested a remedy, but which up to this time we have not been able to apply, as will hereafter appear.

It has always been the intention to extend the side walls far enough down stream to exhaust the capacity of the power, and to close up the span between the walls with piers and gates instead of a tight dam, as is now used; these gates are to be so made as to be opened at pleasure, and the water-way to be left as large as possible. We have thought, and still believe, that to open these gates, say Saturday night (after the close of work) and let them remain open until Monday morning, it would give a flow of water through the entire length of the slough of sufficient volume and force to carry away into the main river below the island all the sediment or deposit that will have accumulated during the week, provided the openings are sufficiently large at the

bridges below, which, I believe, a very slight examination will satisfy you are at present very much too small.

In regard to the deposits already accumulated above the dam, we have always expected to remove the most of that by artificial means, (the upper portion is mostly clean, sharp sand, suitable for building, and such as is now being used at the arsenal at the lower end of the island,) but even if no means except the gates were used to remove this deposit, we believe, (as it is a smooth-rock bottom,) that the whole would in time pass entirely out into the main channel, if, as I before remarked, the bridge obstructions were taken away.

With this submitting of our mode of keeping up the water-power, without jeopardizing the future healthfulness of either the island or its neighborhood, and of increasing the usefulness as a motive-power, it is, perhaps, proper to say to you, that the present dilapidated reputation of the Moline water-power comes from causes heretofore out of our power to remove.

For nearly twenty years this property has been embarrassed and encumbered with mortgages and vexatious lawsuits, and it is only very recently that the end of them seemed to be near.

In July or August, 1863, propositions for purchase were made by our people and accepted by the owners, who live in the State of New York, but an examination of the titles showed such material difficulties that nothing could safely be done; but we think now the indications are that the arrangements may soon be completed as before ageed upon.

You will have noticed that our manufactories have very considerably increased their works, showing their appreciation of the value of the water-power over steam-power, and in this point they have had a large experience, for, owing to the accumulations and consequent shutting out a full supply of water, they have had to resort to steam, and know it is by many times the most expensive motive-power.

The extreme rise of the Mississippi River, as compared with streams flowing from mountainous countries, is so small that no difficulty is experienced in having and keeping perfect control of it, and making it an even, constant, and effective power in all stages of the river.

It will be perceived that any proposition (as seems to be contemplated in your letter referred to) made by us in the present condition of affairs could only be a contingent one.

Our plans and calculations as to future improvements have always been based on owning and occupying the power at both ends of the dam, but the new phase presented by the Government, of taking entire possession of the island side and using the power, suggests that any expenditures for further and more permanent improvement should be done *jointly*, and to this end the parties here who have negotiated for and intended the purchase of this property, as soon as the titles are made right, have authorized me to say they will surrender all their claims to the island side of the dam, and join in all *further* improvements upon any basis which shall be equitable and just to the parties in interest.

In closing, we would respectfully desire to communicate through you to the Department that the suggestion of taking away the dam and altogether destroying the water-power would, if carried out, be not only a great calamity to the town of Moline, but a direct blow at manufacturing interests in this part of the country, and besides would cost the Government in damages many times as much as would be required to make this water-power of the most permanent and efficient character, and so improve it as to secure, beyond question, entire exemption from all local causes of unhealthiness to the island or its surroundings; and would also call attention to the fact that it would impair the navigation of the rapids, which the authorities at Washington became satisfied was considerably improved by building the dams and forcing the water into the steamboat-channel.

I am, very respectfully, your obe't serv't,

CHARLES ATKINSON.

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, Nov. 4th, 1865.

B'v't Brig. General T. J. RODMAN,
Rock Island Arsenal, Ills.:

SIR: Your letter of the 7th inst., in regard to the present obstructions to the flow of water through the minor channel between Rock Island and the Illinois shore, is received.

Please prepare and forward an estimate of the cost of removing these obstructions, so as to protect the healthfulness of the island, and at the same time to derive any benefit that can be made to accrue therefrom in the way of water-power; also what

proportion of this cost will be fairly chargeable to the Government, with your views in regard to the best mode of effecting the object in view.

Resp't'y y'r obe't serv't,

A. B. DYER,
Brig. Gen'l, Ch'f Ord'a.

ROCK ISLAND ARSENAL,
November 18*th*, 1865.

P. R. REED, Esqr.:
Moline, Ill.:

SIR: Pursuant to our conversation this morning, I request that you will inform me on the following points, viz:

1st. As to what damage your company would sustain by the entire removal of your dam.

2d. As to what remedy you propose to apply to prevent the gradual filling up of the slough, preserve the water-power, and secure a healthy flow of water through the slough-channel.

3d. As to what will be the first cost of applying this remedy, and what the annual cost thereafter.

4th. As to what proportion of this cost your company proposes to bear, in view of the United States having the right to use, in perpetuity, one-half of the power thus secured.

T. J. RODMAN,
Major Ord'ce.

ROCK ISLAND ARSENAL,
January 22, 1866.

Major-Gen'l A. B. DYER,
Chief of Ordnance:

SIR: With a view to compliance with your instructions dated November 14, 1865, I addressed to Mr. Reed, then the agent for the water-power co., a letter, of which the inclosed, marked "A," is a copy. This letter was turned over to Mr. Atkinson, now president of the Moline Water-Power Co., a copy of whose reply, marked "B," is also herewith inclosed. This letter will convey to you the views of the water-power company on the subject in question.

Apart from and entirely independent of the views and estimates therein given, the following is an estimate of the cost of removing by artificial means all obstructions necessary to restore the flow of the natural quantity of water through the minor or slough-channel, viz:

To remove deposit in Moline Water-Power Co.'s dam	$26,000
To remove old dam, including deposits, brush, and other rubbish connected therewith	4,000
Total cost of removing all obstructions connected with the Moline Water-Power Co.'s dam	30,000
To remove 200 feet of embankment of railroad contiguous to bridge	1,000
To remove 200 feet of embankment of wagon-road contiguous to bridge	1,000
To remove deposit above and below this embankment	4,000
To extend wagon-road bridge over 200 ft. of embankment removed, including abutments, piers, and bridge	5,000
To extend railroad-bridge over 200 ft. of embankment removed, including abutments, piers, and bridge	8,000
Total cost of removal of all obstructions and preserving bridge to Rock Island City	49,000

The views of the water-power co., as obtained from Mr. Atkinson in conversations had with him, as to the mode of removal of their old dam and the obstructions caused by it, are first to extend their wall down the stream and near the Moline shore 1,000 to 1,200 feet, and then extend the dam across to and at right angles with the island shore, placing sluice-gates and wheel-seats along both wall and dam, so that when the sluice-gates are all open their aggregate water-way will equal the width of the slough at its narrowest point above the dam; then remove the old dam, the material in which the estimates will pay for its removal; then open the sluice-gates in the wall and dam and let the water carry away the deposits in the old dam, aiding the operation, if necessary, by loosening up the deposit by artificial means, when, with the removal of the bridge-embankments at the lower end of the slough, Mr. Atkinson anticipates that the water will carry into the river below the island all deposits above the present dam; and that by opening these sluice-gates at intervals, say from Saturday night till Mon-

day morning of each week, the slough-channel will be kept free from deposit and a healthful flow of water through it secured.

In the soundness of these views touching the removal of present deposits I do not feel entire confidence, being apprehensive that the deposit now above the dam would lodge at different points along the slough below it.

In keeping the channel clear, however, after it shall have been once cleared, and at the same time preserving the water-power, I know of no more feasible plan than that proposed by Mr. Atkinson; and while I fully concur with him as to the importance of preserving the water-power, *if it can be done, and a healthful flow of water through the slough at the same time secured*, I regard the former as secondary to the latter consideration.

Independent of clearing away present obstructions, old dams, &c., it is estimated that the new dam and wall, properly and substantially built of cut stone, including sluice-gates and the means of operating them, will not cost less than $75,000. And in view of the facts that the water-power company had exclusive control of that power and all matters connected therewith, and have enjoyed all its profits since its origin, and that it is now rapidly declining in value as well as obstructing the proper flow of water through the slough, and must soon become worthless as a water-power, owing to accumulation of deposits, and of the want of absolute certainty attaching to the proposed remedy, and of the additional facts that the Government is not yet ready to avail itself of the water-power, and that it must in any event prepare to drive its machinery by steam, in order not to be stopped by failure of or accident to the water-power, it appears to me that the water-power co. should, if they desire the immediate use of the power, proceed at once to build the new dam and walls as above described, clear away their old dam and all other obstructions connected therewith, and fully test the efficiency and permanence of their proposed remedy; then, if the remedy shall prove efficient and permanent, the United States should pay to the water-power co. one-half of the cost of construction, with compound interest on that amount from the date of its expenditure by the company to the date of payment by the United States, and bear thereafter one-half of the expense of repairs to the dam and wall, and have the right in perpetuity to use one-half of the power thus secured.

T. J. RODMAN,
Major Ordnance.

MOLINE, *January* 8, 1866.

General T. J. RODMAN:

DEAR SIR: In answer to your request that I would reply to your inquiries made of P. R. Reed, esqr., permit me first to say, that by the terms of the charter authorizing the building of a dam from the main shore to Rock Island, the *whole* water-power created thereby was granted to the builders and their assignees, the occupation of which has not only been acquiesced in and recognized by the Government, but has been encouraged, and the owners are not now willing to believe that the U. S. propose to impair these rights without making a fair equivalent.

The questions to Mr. Reed, as I understand them, are:

First. What amount of damage will this company sustain by entire removal of the dam?

Second. What remedy is proposed to prevent further accumulations, and what plans for further improvement?

Third. What will be the first cost, and what annually thereafter?

Fourth. What proportion this company propose to bear in view of the U. S. having the use in perpetuity of half the power?

My reply to the first question is that the company are unwilling to name any sum for which they could agree that the dam may be removed and the water-power destroyed; for, besides the great injury to its interests as a company, the damage to individual manufacturers (as I have ascertained by careful investigation) would be a no less sum than *two hundred and fifty thousand dollars*, and the damage to the real estate in the town of Moline could not be estimated less than fifty per cent., the value of which is indicated by the assessors' books to be over six hundred thousand dollars, so that the actual damage sustained by its removal would be so many times more than the outside cost of putting it in the most perfect condition for use, and securing, when needed, a healthful flow of water, that it would seem ill-advised and very much out of place to name any sum for which it could consent to an arrangement that would so effectually ruin the present and prospective manufacturing interests of Moline.

In answer to question number two I would say, the remedy always heretofore proposed to prevent further accumulation has been to extend the walls a proper distance down stream and fill across between these walls, with piers and gates so arranged as to be opened at pleasure, and thus create, when opened, a strong current through the whole channel.

Or if the Government adheres to the plan of occupying the whole island, (which, I understand you, is its present purpose,) and shall decide to use water-power, there would be no need of a wall on the island side, but let the water lay against the bank, and use it at the openings where the piers and gates touch the shore. Or in order to get the power still lower down and nearer to where the Government shops are to be located, these piers and gates may be placed obliquely across from the lower end of lower wall to the shore and the power taken at the lower openings, which, being so far down, will secure the best head and freest discharge of water from the wheels, and furnish power which will be permanent, reliable, and to an almost indefinite amount, and as safe as water-power can be made. A portion of the upper end of the bar in the pond must be removed by artificial means, but the lighter part, (by a little stirring up,) as well as the accumulation below, will all wash out into the main river when the bridge openings are properly enlarged.

In answer to question number three, as to the first cost and annual expenses hereafter, it is estimated that from *fifty to a hundred thousand dollars* can be judiciously expended on this water-power, which being done, it will be permanent, secure from flood or disaster, and of ample capacity for all Government purposes, strengthen the capacity of the power on the Moline side, which now is the basis of the product of from *one to two millions of dollars* of manufactured commodities per annum.

After the first outlay the annual expenses will be merely nominal.

The answer naturally suggested by question number four would be that if Government appropriate to itself the whole upper end of the island and require this company to surrender to the U. S. the use in perpetuity of one-half the water-power created by their dam, it can well afford to make the improvement suggested, when by so doing it saves an actual damage of over half a *million* dollars, a permanent power is obtained for its own uses, and it aids to utilize natural forces rather than destroy, encourages rather than restrains manufacturing energies, now so much needed, especially in the West. Whereas the opposite course of removing the dam destroys its own water-power advantages, entails a heavy amount of real damage to manufacturing interests, and small property-holders that are illy able to bear it, and whose claims to justice cannot fairly be ignored, and also seriously damages the navigation of the Upper Rock Island chain, which by river-men was regarded largely improved when the dam and wing were built. The expenditures I have suggested contemplate an extensive addition to the wing-dam, which will tend to help the navigation of the rapids in proportion to the distance it is carried up.

Over twenty years' experience and practical knowledge in the matter gives us a confidence which others less acquainted may not have, and which is indicated by the substantial improvements connected with the power.

In closing allow me to say I believe the damage to navigation over the Rock Island chain alone would be more than is required to make all the improvements required.

I am, with great respect,

CHAS. ATKINSON,
President Moline Water Co.

CHAPTER 141.—(Approved June 27, 1866.)

AN ACT making further provisions for the establishment of an armory and arsenal of construction deposit, and repair on Rock Island, in the State of Illinois.

SEC. 4. That the following sums be, and they are hereby, appropriated, out of any money in the Treasury not otherwise appropriated, for Rock Island arsenal, to be applied as follows, viz:

To liquidate claims for property in Benham's, Wilson's, and Winnebago Islands, and for property in Rock Island, which has been taken in pursuance of law, for military purposes, two hundred and ninety-three thousand six hundred dollars, or so much thereof, and no more, as may be necessary to pay the respective claimants; such amounts as may be reported by the board of commissioners authorized by the act of April nineteenth, eighteen hundred and sixty-four, and ordered by the United States circuit court to be paid to each.

To secure water-power at the head of Rock Island, one hundred thousand dollars.

ROCK ISLAND ARSENAL,
August 15th, 1866.

Major-Gen'l A. B. DYER,
Chief of Ordnance, Washington, D. C.:

SIR: Since the receipt of your letter of 4th inst., calling for my views and recommendations as to the most advantageous mode of securing water-power at this arsenal, I have conferred fully with Mr. Atkinson and other members of the Moline Water-Power Co. as to their right to and claims upon that power, and the best mode of improving it. This company claims, under the laws of Illinois, to own the whole of the water-power secured by the dam running from Rock Island to the Illinois shore; and

Mr. Atkinson informs me that he understood the question to have been settled last winter, between you and me and himself, and that members of Congress Harding and Washburne so understood it, on the basis that the United States were to give to the company, or expend it for its benefit, $50,000 out of the $100,000 appropriated "to secure water-power at the head of Rock Island," and receive therefor the right to use one-half of said power. I do not so understand it, and I have informed Mr. Atkinson, as I now inform you, that my views relative to the rights of the United States in *equity* are substantially the same now as given in my letter to you dated January 22, 1866.

The company are unwilling to refer the question of rights and equities between them and the United States to the commissioners recently appointed to adjust claims for property taken by the United States on this island for military purposes.

I am not sure that an error has not been committed by my predecessor, and up to this time acquiesced in by me, in not taking possession, under the act of April 19, 1864, of the *water-power* claimed by the Moline Water-Power Co. at the island end of their dam, as well as of the premises in which that power is used, and for the use of which power that company is in the receipt of rents. Should this course be deemed to have been contemplated by the act above cited, it could be adopted yet, and would bring the question of equity between the company and the United States before the commission above referred to; and should the hereinafter-cited propositions not meet the views of the Department, I would recommend this course.

The company have offered to allow the United States to have and use ($\frac{2}{3}$) two-thirds (and Mr. Atkinson has gone as far as ($\frac{7}{10}$) seven-tenths) of the whole power, on condition that the United States build and keep in repair the entire wall or dam, and clean out deposits from D to A and allow the company to use the other third or three-tenths free of charge. And I believe the company *may* permit the United States to use ($\frac{3}{4}$) three-fourths of the power at these terms, the United States putting in arches in the wall below the company's dam, and renting on equitable terms, to be used on the Illinois shore, such amount of power as they may not require and for such times as they may designate.

The estimated cost of erecting a permanent and substantial wall, with suitable wheel-seats and sluice-gates between the points A and B, is $300,000. For clearing out deposit in company's present dam, say $30,000. For repairing and extending wing-dam above Benham's Island, say $20,000; making the total estimated cost of $350,000 for securing at the point A say $\frac{3}{4}$ of the whole power, or say 2,000 to 2,500 horse-power, and at Benham's Island 300 horse.

The cost of water-wheels, shafting, gearing, pumps for condensing air, a suitable house in which to place them, and of the pipes in position for conveying this power from the point A to the shops will not, I think, be less than $200,000; making a total cost of $550,000. This is a large sum to expend at once for power. But the cost of running 1,500 horse-power ten hours per day, by steam, for one year, at 10 pounds of coal per horse-power per hour, and coal at 18 cents per bushel, (the lowest price that I have paid here,) is $101,250, while the interest on $550,000 at 7 per cent. is $38,500. And if required to run day and night, the cost of steam-power will be doubled, while that of water-power will be slightly increased.

It is true that the Government will not probably require anything like all of 2,000 horse-power at present, or in ordinary times of peace, but it should have an ample supply to meet all contingencies and future extensions of operations here. So that, if the Government goes to the expense of using any water-power at the shops here, as the above figures, I think, show that it should, it ought to secure the right to at least ($\frac{3}{4}$) three-fourths of all that can be reasonably developed at the company's dam; and in view of the fact that large manufacturing establishments have been built and are in operation which derive their power from their dam, and of the fact that the retention by the company of but one-fourth of the power diminishes the number of establishments that can be put in motion by it, and thereby diminishes the value of their other property in the vicinity, I am inclined to think that if the company will cede to the United States three-fourths of the whole power on the terms hereinbefore stated the Government ought to accept it as an equitable adjustment. An additional reason of this arrangement is that it avoids all partnership and complications in the construction and maintenance of walls, dams, &c., placing the whole control of construction, both as to character and execution, in the hands of the Government.

Should the question be settled on this basis, the removal of the deposit in the mouth of the company's present dam becomes a necessity, and by constructing a railroad from the head to the foot of the island, which is contemplated in any event, this deposit could be readily removed to the contemplated site of the steamboat-wharf just below the present railroad-bridge, where a large amount of filling will be required to make a proper wharf. And under these circumstances, I would recommend that so much of the $100,000 "to secure water-power" as may be necessary for that purpose, say $30,000, be expended in repairing, and perhaps extending, the wing-dam above Benham's Island to the point E, which would increase the power at both Benham's Island dam G and

at the dam from A to D, and the remainder in preparation for the removal of the deposit in the company's dam as above and for constructing the wall between A and B. Please advise me of the views of the Department on the points herein discussed as soon as practicable, as I shall want to estimate for the construction of the wall above referred to, if it is to be built, and the company are anxious to have the water-power question settled, so that they may go to work on a new dam if the Government declines to do so, and I do not feel that I ought to settle definitely, or so as to bind the Government, a question of such magnitude as that now under consideration.

I am, sir, very resp't'y,

T. J. RODMAN,
Maj. Ordnance.

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, Aug. 22, 1866.

B'v't Br. Gen'l T. J. RODMAN,
Com'd'g Rock Island Arsenal:

SIR: Your letter of the 15th inst., in relation to securing water-power at Rock Island has been received and duly considered.

This Department has neither the authority nor the means to provide water-power according to the plan and at the estimated expense mentioned in your letter, even if it were deemed advisable to do so instead of relying upon the use of such steam-power as may be necessary for ordinary operations, or may become so hereafter under more enlarged ones. With our present means and authority, the best course to pursue seems to be this: to ascertain the title now held by individuals or companies to the water-power, and to take possession of the same, so far as it may be done under the 1st section of the act of April 19, 1864, authorizing and empowering the Secretary of War "to take and hold full, complete, and permanent possession, in behalf of the United States, of the lands and shores of the island of Rock Island."

This taking and holding should, of course, only be done if necessary for the purposes of the Government in its occupancy of the island for military purposes, and so far as it may be necessary. Any claims for loss or damage arising therefrom will then have to come before the commissioners and to be settled as provided by law.

After the Government shall have thus acquired possession, made settlement, and obtained title, the securing of water-power at the head of Rock Island may be proceeded with, if deemed advisable and approved, to the extent of the means appropriated therefor. But no work can be done, nor plan undertaken, nor agreement entered into for this object involving a cost exceeding that appropriation.

Respt'ly your obed't ser't,

A. B. DYER,
B'v't Maj. Gen'l, Ch'f Ordnance.

On the 27th August, 1866, General Rodman notified the Moline Water-Power Company to vacate on September 1, 1866, in behalf of the United States, all of that portion of the Moline Water-Power Company's dam lying north of the middle line of the channel of the Mississippi River separating the island of Rock Island from the Illinois shore, together with the whole of the water-power developed and secured by said dam north of said line; also all other lands, sand-bars, or deposits of sand, stone, or other materials lying contiguous to said island and north of the aforesaid line, and which may be in the company's possession or claimed by them.

On the 22d of September the Chief of Ordnance granted the Moline Water-Power Company authority to collect rents accruing from the use of their water-power, pending the examination and decision of the question as to the right of the company to any property on the island of Rock Island or its shores. This privilege was given upon the express condition that it was revocable by the authority granting it, whenever the question regarding the rights of the company should be, in the judgment of that authority, settled.

The company was to signify their acceptance, in writing, of the above understanding and agreement.

On the 27th of September, General Rodman acknowledged the receipt of a copy of a letter relative to the collection of rents by the Moline Water-Power Company. He stated that he would take no action in the

matter until advised by the Chief of Ordnance of the acceptance by the Moline Water-Power Company of the conditions mentioned in that letter.

The action taken by the board of commissioners appointed by the President of the United States to adjust claims growing out of the action of the United States in taking possession of property at the Rock Island arsenal, under the act of Congress approved April 19, 1864, in the case of the Moline Water-Power Company, and the recommendation by the board of a plan for the settlement of matters between the United States and that company, are embodied in the report of the board, copied in Chapter IV.

The recommendation in this case is very long, and is not copied again here. Briefly, the plan recommended by the board was, that the Moline Water-Power Company should convey to the United States the fee of the entire water-power. In return for this the United States should develop and construct the water-power, and give to the Moline Water-Power Company, in perpetuity, free of cost, one-fourth of all the power obtained and the privilege of renting at the nominal price of fifty (50) cents per square inch of cross-section of water at openings, per annum, all the water that the United States should not at any time require for use at the arsenal. This plan has been fully carried out, and the recommendations of the commission are nearly all embodied in contracts made between the United States and the water-power company, which will appear in the further history of the water-power. Nevertheless, a careful reading of the report of the commission on this subject would be useful for a clear understanding of the subsequent action taken respecting it.

The Chief of Ordnance, in submitting the report of the commissioners to the Secretary of War, for his action thereon, made the following remarks in regard to the recommendations in the case of the water-power company:

Extract from letter of Chief of Ordnance transmitting report of the Rock Island commission.

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, February 8th, 1867.

To the SECRETARY OF WAR,
Washington, D. C.:

SIR: I have the honor to transmit herewith the report of the commission appointed under the acts of Congress approved April 19th, 1864, and June 27th, 1866, to ascertain the true value of the land on Rock Island taken possession of by the War Department, and the compensation due each claimant.

* * * * * * *

You will observe that no award has been made to the Moline Water-Power Company for the improvements made by it in creating its water-power; and as the land upon the island upon which the improvements are located belongs to the United States, it is doubtful whether the commission had authority under either of the acts above named to award damages to this company, the power to award damages being limited by the acts to claims for the value of the lands owned by individuals and taken possession of by the War Department. Still, as this company was permitted to make these improvements upon public property, it is doubtful whether it should be taken from the company without compensation.

The recommendation of the commission indirectly gives compensation to the company, and at the same time promotes the interests of this Department in securing water-power for the arsenal. If the War Department has authority to sanction and carry into effect this recommendation, I respectfully suggest that it be done.

If further legislation is necessary to that effect, I recommend that it be requested of Congress as soon as possible.

Very respectfully, your ob'd't serv't,

A. B. DYER,
Brig. Gen'l, Ch'f of Ord.

To carry out the foregoing recommendations, the following resolu of Congress was passed:

RESOLUTION No. 54.—(Approved March 2, 1867. Vol. 14, p. 573.)

JOINT RESOLUTION to enable the Secretary of War to carry out an agreement in relation to w power for the arsenal at Rock Island.

That the Secretary of War be, and he is hereby, authorized and empowered to ca into effect the recommendations of the commissioners appointed under the acts of Ap nineteen, eighteen hundred and sixty-four, and June twenty-seven, eighteen hund and sixty-six, relative to the Moline Water Company and the water-power at Ro Island, Illinois, as contained in the report of said commissioners, and to make applic tion for that purpose of the money heretofore appropriated for securing water-pow at the head of Rock Island.

On the 9th of April, 1867, the Chief of Ordnance sent to General Rodman a draught of an agreement for the signature of the Moline Water-Power Company, which embodied the recommendations of the commissioners.

On April 16, 1867, General Rodman returned this agreement and inclosed a copy of a letter from the Moline Water-Power Company, dated April 15, 1867, stating that the company did not think the agreement fully covered all the points recommended by the commission, but the president of the company was authorized to execute the same on behalf of the company after adding the following words:

It being further understood that this agreement is for the purpose of carrying out the recommendations of the commissioners appointed under the acts of April 19, 1864, and June 27, 1866, relative to the Moline Water-Power Company, and water-power at Rock Island, Illinois, and that the recommendation of said commissioners now on file at the Ordnance Department at Washington City is regarded as a part of this agreement.

General Rodman stated that he did not feel authorized to add the clause, but that he could see no objection to its being added.

The agreement was returned by the Chief of Ordnance, under date of April 19, 1867, with the additional clause inserted, as requested by the Moline Water-Power Company.

One clause of this agreement was again modified in the following June, and before giving a copy of the agreement, as finally executed, it will be best to explain the circumstances which led to this modification; especially since it was the cause of a change in the amount of money expended on the wing-dam, or, more properly, of the amount of money paid out by the Ordnance Department, and has sometimes caused complaints.

In 1866, (by act approved June 27, 1866,) Congress appropriated $100,000 for the water-power. It had been agreed, verbally, that $40,000 of this sum should be expended on the wing-dam, and the remaining $60,000 on the stone dam for utilizing that part of the power which the agreement gave to the Moline Company. There was a clause put in the agreement (third clause) requiring $40,000 to be expended on the wing-dam. The anxiety for this clause on the part of the Moline Water-Power Company was caused by the fact that it was supposed the wing-dam would give more benefit to the part of the power to be used by that company than it would to the part to be used by the Government. (This belief was without good foundation. The wing-dam has the same effect on one part of the power that it has on the other.) Further appropriations would probably be made to complete the dams and other parts of the water-power in accordance with the plans, but the Moline Company did not feel so sure that the wing-dam would be

completed in the way that company wanted it, and as they were anxious about it, this clause was made a part of the agreement. It was not convenient to stipulate in the agreement exactly what work should be done on the wing-dam, but the plans for the dam were made and agreed upon verbally, and the estimated cost was carefully determined and found to be within $40,000. Then the third clause of the agreement was made to specify that this sum of money should be expended, and this covered the case. Afterward, while the wing-dam was being built, it was found that contractors, doing work for the United States Engineer Department in the improvements of the rapids of the Mississippi River, were excavating rock from the bed of the river near the site of the wing-dam. Authority was obtained from the Engineer Department to have this rock delivered on the dam. This was done, and the only expense which the Ordnance Department incurred in the construction of the rock part of the dam was the cost of unloading the rock, and a considerable part of this labor was performed by enlisted men. As the largest item in the estimated expense of building the dam was the cost of rock, delivered as required, it was found that with this arrangement the dam could be built in accordance with the plan agreed upon for much less than $40,000. General Rodman then proposed to deduct from $40,000 the value of the rock delivered at the dam and expend the remainder; but he was informed by the Chief of Ordnance (see letter from the Chief of Ordnance to General Rodman, dated May 29, 1867) that this could only be done by consent of the Moline Water-Power Company, and if that company insisted upon it, the whole $40,000 would have to be expended upon the wing-dam in accordance with the agreement. The Chief of Ordnance, however, suggested that the agreement (which, I believe, had not yet been executed) be changed to suit the case. This was done by consent of the Moline Company, and the third clause amended to read: "3d. The United States of America hereby agrees to apply forty thousand dollars, *or so much thereof as the War Department may consider necessary*, to complete the wing-dam," &c., the words in italics being added to the original agreement to make the clause suit the case.

The total amount paid out in the construction of the part of the wing-dam in which the Moline Company was interested, in accordance with the foregoing, was $29,681.65.

The remainder (a little over $10,000) was reserved, as General Rodman's letters show, for connecting the wing-dam with Benham's Island and Sears's dam, and for repairs of Sears's dam.

It was subsequently claimed by the Moline Company that the United States did not carry out this part of its agreement, because the whole $40,000 was not expended on the wing-dam, and complaints have been based upon this claim. On this account a full statement of the matter is given. The letters pertaining to this subject are not copied, because it is unnecessary. They are as follows: From General Rodman to the Chief of Ordnance, dated May 24 and June 5, 1867; from the Chief of Ordnance to General Rodman, dated May 29 and June 10, 1867; from General Rodman to Moline Water-Power Company, dated June 3, and their reply dated June 4, 1867.

The agreement, after being amended, was executed by the Moline Water-Power Company, and sent to the Chief of Ordnance, June 19, 1867. This is the agreement still in force between the United States and the water-power company, and contains the principal matters of contract between the two contracting parties. It has been amended and supplemented by additional contracts several times since, and as all of these agreements

are important documents for convenience of reference and consultation, they are placed together in order of occurrence in an appendix at the end of this chapter. This first agreement is marked "A" in the appendix.

Before giving an account of the construction of the wing-dam, it will be best to explain what were the plans respecting the water-power at this time. These plans are set forth in a letter from General Rodman to the Chief of Ordnance, dated May 20, 1867, and can be understood by reference to the map on Plate XI. Prior to this, in the summer of 1866, there was considerable correspondence on the subject of the water-power, and the letters on the subject give the plans for the work as they stood at that time.

A short description of the water-power will be useful for understanding the papers and maps on the subject.

The distance from the head of the wing-dam to the foot or west end of Rock Island (see map on Plate XI) is 3.20 miles. The fall of the Rock Island rapids in this distance is 6.65 feet at high water, and 7.55 feet at low water. To obtain a water-power, this fall, or so much of it as is practicable, must be concentrated at one point. This is done in the south or "slough" channel by building a dam across it. The fall or head obtained at the dam is the total fall of the rapids given above, less the slight fall of the surface of the water in the pool above the dam and the fall in the tail-race, or so much of the channel as is below the dam. At low water this last amount to be deducted is considerable. At high water, of course the water backs up into the tail-race, makes the surface of the water in the tail-race nearly level, and the amount of fall to be subtracted is inconsiderable. This gives a fall or head at the dam as follows, (see map on Plate XI:)

At the east end of the dam O O, where the Moline Company uses its water—

At high water, 6.45.

At low water, 5.45.

At the lower end of the dam K K′, where the United States uses its water—

At high water, 6.65.

At low water, 6.25.

The location of the dam, as proposed by General Rodman in 1866, is shown on the map on Plate I.

The plan as proposed in 1867 (see General Rodman's letter of May 20, 1867, copied a few pages further on) was to build a masonry dam along the line O O O′ to A. (See map on Plate XI.) The Moline Company was to use its water at the east end of this dam O O, and let its water pass along the tail-race formed between this dam and the shore. The United States would use its water at the lower or west end of this dam at O′ K. This was the plan for which the first agreement (see Appendix A at end of this chapter) was framed.

This plan was subsequently changed in 1869. By the new plan the dam O O was to run in to the shore of the Moline Company's land at d, and a canal was to be dug to carry away the Moline Company's tail-water from S′, and discharge it into the river below the site of the dam, where the United States would use its water. This is the plan upon which the water-power was subsequently constructed.

The dam last mentioned was not located when the plan was made, but was subsequently located on the line K K in 1872.

This plan caused a new agreement between the United States and the Moline Company to be made, which is given in Appendix B to this

chapter. This plan brought the "pool" or dammed up water against the Moline Company's land along the shore-line *d* K, and necessitated the construction of a dike to prevent the overthrow of the company's land. The dike *n d'*, to prevent overflow upon the island, had to be built in either case.

If these plans for a water-power are deemed peculiar or expensive, it should be borne in mind that the report of the board of commissioners and the legislation and agreements based thereon required that the United States should construct the water-power and give the Moline Company one-fourth of the water. This obligation was the payment which the United States made to the Moline Company for its property, that is, for its share of the water-power. Under this obligation the water-power had to be so built that the Moline Company could use its fourth of the water, and it could use it only at or near Moline. It had also to be so built that the Government could use its three-fourths, and the arsenal required this three-fourths near the arsenal shops. If a dam were built across the channel at or near Moline to suit the wants of the Moline Company, then the Government could have no power one and a fourth miles below, where it required it; and, *vice versa*, the Moline Company could have no power if the dam were built below. The head was too little to admit of its division by building a dam at both places and using the same water twice, hence the peculiar construction described; and the peculiarities of the case admitted of no better construction.

Had the United States purchased all the rights of the Moline Company by paying a sum of money for the same, then the Government would have needed only to build its dam such as K K across the channel and protect the shores of the pool from overflow by the inexpensive dikes necessary for this purpose. This would have saved the expense of the great dam-wall from *o* to *d*, 4,000 feet, and the canal, 2,000 feet long and 200 feet wide, through limestone rock, which have been built solely to enable the Moline Company to use its share of the water, and have cost about $500,000. It is presumable that the rights of the company could have been purchased for a less sum than this, and the United States would then have been left sole owners of all the power, and would have been free from a troublesome, "entangling alliance" with a private corporation.

At *p* on the map is shown the wooden bulk-head put in by the Moline Company, and frequently mentioned in papers relating to the water-power. It was a temporary structure to make a portion of the water-power available for use by the Moline Company while the construction of the remainder was going on, and it has since been removed.

The line of the Moline Company's old dam (partly washed out in 1868 and entirely removed in 1869) is shown at *n n n n* on the map. This line may not be absolutely correct, but it is as nearly so as I can determine.

The wing-dam built by the United States is shown on the map from Benham's Island to C. The small piece G is the piece referred to in papers as being at Gordon's Landing. The piece H I is a cheap, narrow wall of loose rock, rising only a little above the surface at low water. I have never understood clearly what object was sought in putting in these two pieces, and they have never accomplished any good.

The proposed channel, marked M M' on the map, the piece of wing-dam C N, and the long dotted lines showing a proposed wing-dam to A are to explain some history of the water-power of a much later date, and will be described in the proper place.

It is believed that the foregoing description and explanation will enable the reader to understand all papers on the subject of the water-power without much difficulty.*

On the 20th of May, 1867, General Rodman sent to the Chief of Ordnance plans for the improvement of the water-power, with the following letter:

ROCK ISLAND ARSENAL, ILLS.,
May 20, 1867.

Brevet Major General A. B. DYER,
Chief of Ordnance:

SIR: In compliance with yours of the 30th ulto., I have the honor to inclose herewith tracings of plans of proposed improvements of water-power at the head of this island.

Sheet No. 1 shows the plan of these improvements. I propose to commence at the head of Benham's Island and raise the wing-dam up to near the high-water line, by filling in rubble or broken stone and earth or sand and mud now deposited in the dam, and to extend this wing-dam as far up the river, along the line shown on the plan, as $40,000 will build it. I also propose to commence at the lower end of the present wall of old dam, and build along the broken line a stone wall 20 feet high by 10 feet at base and 4 feet at top, with a 10-inch thick stone coping, as far as $60,000 will build it.

The water-power company desires that openings shall be built in this wall, as shown in sheet No. 2. One double opening in every 100 feet, or one treble opening in every 150 feet. This wall should, in my judgment, be built with cement instead of lime, and of large, sound stones, well bedded, with fragment headers in every general course, extending well into the wall. The stones forming the outer and inner faces of the wall should be squarely jointed, but not dressed on the exterior. It need not, I think, be strictly "range work," but each general course should not, at any point, be composed of more than two thicknesses of stone. The interior of the wall should be composed mainly of large, sound stones, the interstices being well filled in with smaller stones and cement. The coping only need be dressed along the joints and edges, and properly bedded.

Very respectfully, your obed't servant,

T. J. RODMAN,
Lieut. Col. of Ordnance and B'v't Brig. Gen'l, U. S. A.

On the 26th of December, 1867, General Rodman, in reply to an inquiry from Mr. B. Davenport relative to the proposed crib-work in the Mississippi River opposite to his property in Moline, explained its object, and received the following reply:

ROCK ISLAND, ILLINOIS, *January* 3d, 1868.

Brig. Gen. T. J. RODMAN, U. S. A.,
Rock Island Arsenal, Rock Island, Illinois:

SIR: Your communication of the 26th ult., relative to the crib-work in the Mississippi River opposite my property above the town of Moline, is received, stating that for the purpose of improving the water-power belonging to the United States at the head of the island of Rock Island, it is proposed to build the "crib-work" without openings, say, three to five feet above low water, the exact height yet to be determined.

The above property has a river-front a mile in length, which, by the proposed crib-work, will be entirely shut off from access to steamboats and other crafts navigating the river. Parts of the bank above the underlying rock are now washed at the higher stages of water, and a portion of the land is but little above the usual high water, and the effect of the proposed improvement in raising the general water-level will be to work very serious damage to the property in question by the washing away of the banks and the overflow of a portion of it.

I do not wish to put any obstacle in the way of the proposed improvement, but, on the contrary, am desirous of facilitating the work as far as possible, and it would seem that I ought not to be materially damaged by it.

It appears to me to be no more than right that the Government should secure the banks from washing by a facing of rough stone, commonly called "riprap-work," or some other proper means, and should, by dikes, or levees, protect the land from overflow, and I am willing, in the event of being so protected, to release the United States

* In the copies of papers relating to the water-power, letters and marks referring to accompanying drawings are sometimes omitted, because the drawings do not accompany this book; when these references are important, they are made to coincide with the map on Plate XI, and are given.

from all claims by reason of damage done said property by such improvement. The said crib-work in no event to be built more than five feet above low-water mark.

I am, sir, very respectfully, your ob't serv't,

BAILEY DAVENPORT.

General Rodman referred this case to the Chief of Ordnance for his information and further instructions, as follows:

WASHINGTON, *February 6th*, 1868.

B'v't Maj. Gen. A. B. DYER,
Chief of Ordnance:

SIR: I have the honor to report that in pursuance of the plans presented by me and approved by the Department, for the construction of the wing-dam for developing the water-power at the Rock Island arsenal, I had commenced work at that improvement, and that in consequence of having been advised by Mr. B. Davenport that he should claim from the United States remuneration for any damage that might be done to his property from overflow or abrasion of shores consequent upon the construction of said dam, I have deemed it proper to discontinue work on said dam until the further instructions of the Department shall have been received.

The probability of serious damage to Mr. Davenport's property from the erection of the wing-dam is, in my judgment, remote, as the dam opposite this property will not exceed three feet in height above ordinary low water, and there will be a depth of about twelve feet on the top of the dam at high water.

Please give your instructions on this subject.

I am, sir, respectfully, your ob't serv't,

T. J. RODMAN,
Lt. Col. of Ord. and B'v't Brig. Gen. U. S. A., Com'd'g R. I. Arsenal.

The following answer was received to the above letter:

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, February 8th, 1868.

Brevet Brigadier-General T. J. RODMAN,
Commanding Rock Island Arsenal:

SIR: In reply to your letter of 6th instant, asking instructions as to whether you shall resume work on the wing-dam for developing the water-power at the Rock Island arsenal, I have to state that your letter was submitted to the Secretary of War, with recommendation that the work should go on as authorized, and that he has approved that recommendation. You will therefore resume work on the dam, as advised by telegraph this morning.

Respectfully, your ob't serv't,

A. B. DYER,
Brevet Major-General, Chief Ordnance.

As the drawings and records of the arsenal gave no full description or history of the construction of the wing-dam, I obtained, in 1872, from Lieut. W. P. Butler, who was familiar with it, a special report on the subject. The following are extracts from this report, and on Plate XII are shown cross-sections of the wing-dam:

Part H I, 1,300′ long, was built in November and December, 1867, by Major Edson, then in temporary command of Rock Island arsenal. Plain crib-work, 10′ from out to out, mddl. of 6″ × 8″ pine timber, fastened by oak pins, filled with loose stone to about 3′ above low water. The work was done by a foreman, two laborers, and five enlisted men. The stone was from Duck Creek chain, one mile distant, transported in lighters by Case and Company, and unloaded by the Ordnance Department. The cribs were built on lighters and lowered in place. Rate of progress 80 feet per day. Lumber in 100′=4,300′, at $17.00 per thousand. Total cost of dam, $1.00 per running foot. The plans not having yet been returned to General Rodman, he declined to make the United States liable for this work. The lumber was furnished by Chas. Atkinson, president of the Moline Water-Power Company, who was afterward to be paid for it by the United States. General Rodman made a proviso that this should not be construed to confer any right of ownership in Mr. Atkinson. Part D E, in deep water, was built in February and March, 1868. Cribs of 6″ × 8″ timbers were built on the ice, and lowered in place and filled with stone quarried about 1,000′ S. W. of Sears's dam, and hauled in wagons to the wing-dam. A few cribs were made 15′ wide at the bottom and 12′ at

the top on the outside. This was found to be costly, and the rest were made 12′ wide at the bottom, without batter. Part A B C D was built from July to October, 1868. The cribs are 12′ wide from A to C, and 10′ from C to E. It was not at first intended to cover over the cribs entirely, and a continuous apron, 4′ wide, was made for about 600′ from Benham's Island, to prevent underwashing. The timbers are 6″ × 8″, 6″ × 6″, and 8″ × 8″, fastened by oak pins.

A rope was stretched from the wing-dam to the coffer-dam on Moline chain, and used for a current-ferry. The stone was all delivered on lighters by Case and Company, and unloaded by Ordnance Department. Cost per loose yard of stone in position, 39 cents. Average cost per running foot of completed dam A B C D, $8.00. Part E F was built from November 17, 1868, to June, 1869. An ordinary coffer-dam, made of old boards and filled with earth, was put in and covered over entirely with stone purchased of Chas. Atkinson, at $1.00 per loose yard. The stone was delivered on Moline shore by Mr. Atkinson, and loads transported and unloaded by Ordnance Department. Cost of completed dam E F per running foot, $11.00. The wing-dam was intended to be 1′ above high water for the first 400′ from Benham's Island, to make a log-harbor. The next length was to be 8′ above low water, the next 5′ above low water, to the west line of Bailey Davenport's property, and all east of that line 3′ above low water.

After the completion of the dam, a large quantity of the sand and mud excavated from the water-power pool was deposited along the wing-dam. It was the opinion of General Rodman that an extension of the wing-dam much beyond Gordon's Landing would not be beneficial, as such an extension would necessarily make the mouth of the pool narrower.

It is my own opinion that it would not be advantageous to connect Gordon's Landing with the upper part H I, unless the dam should be made more nearly water-tight than it is now. The mouth of the pool in this case would be but —— wide, and the small increase of head would be nearly compensated for by the leakage, and this narrow opening would be liable to be frequently gorged by ice, the river being shallow at the point I.

THE UPPER DAM-WALL.

This wall is marked *o f* on the map, (Plate XI), and in papers is sometimes called the Moline dam wall to distinguish it from other water-power constructions. At *o n* is shown a crotchet in the wall. It was intended originally to build the wall from about the point *n*, along the line where the Moline Company's old dam had been. The crotchet was built out to *o*, and the wall built from that point at the request of the Moline Water-Power Company, and that company paid the increase of cost caused by the change of location. This crotchet now acts as a retaining-wall for the earth embankment approach to the Government bridge to Moline. (*n p* on the map.) A cross-section and elevation of the dam-wall are shown on Plate XII. The elevation shows one of the "water-ways" mentioned in papers on this subject. These water-ways are now always called gates. There are thirty-seven of them in this wall, built solely for the use of the Moline company. And this number, it was estimated, would supply that company with all the water they will ever require or all that they can ever be allowed to use under their contract. These gates might give, with water-wheels of the maximum size consistent with economy, about 1,900 horse-power.

The height of the wall from the rock-bed of the river is generally about 18½ feet. Its height above low water* is 16½ feet. It is 8 feet thick at the base, 3¾ feet thick under the coping, and the coping is 1 foot thick and 4½ feet wide. The wall is strengthened by sloping buttresses 3 feet wide, and 3 feet thick at the base, and placed 15 feet apart. The total length of the wall is 2,307 feet.

It was begun in June, 1868, and finished in December, 1869, except about 100 feet at the lower end, which was not built till 1872.

The stone was furnished by Messrs. Sanger & Steel, of Joliet, Ill.; was brought to Moline by rail, and transported from the railroad-track in Moline to the bank of the river near the wall on a special railroad-

* Low water here means low water in the tail-race. The water is, of course, higher in the pool.

switch laid for that purpose. After being dressed it was wagoned down to the site of the wall in the river, and was set with boom-derricks. Little or no difficulty was experienced in getting good foundations, the bed of the river being good solid rock throughout. The total cost of this wall was about $217,000.*

The following are several letters and papers pertaining to the water-power, which are interesting, and which need no explanation except what has been given:

MOLINE, *June* 9, 1868.

B'v't Brig. General T. J. RODMAN:

SIR: Our manufacturers think that the space between the wall and your coffer-dam at Moline, as now being placed, will tend to obstruct the discharge-water from their wheels, and have instructed me to say that if you will change it, so as to increase the space about fifty feet additional to what it is now, this company will pay the additional expense that may be incurred by such change by the United States.

With great respect, I am, your obedient servant,

CHARLES ATKINSON,
President Moline Water-Power Co.

General Rodman changed the position of the dam as requested, and upon the conditions named in the foregoing letter.

[PUBLIC No. 38.]

AN ACT making appropriations for the support of the Army for the year ending June thirtieth, eighteen hundred and sixty-nine, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, out of any money in the Treasury not otherwise appropriated, for the support of the Army for the year ending the thirtieth of June, eighteen hundred and sixty-nine:

For repairs and improvement of armories and arsenals.

For arsenal and armory at Rock Island, Illinois, three hundred and eighty thousand dollars: *Provided*, That eighty thousand dollars of said sum shall be devoted to the development of the water-power, to carry out existing contracts.

Approved June 8th, 1868.

ROCK ISLAND ARSENAL, *June* 15, 1868.

Brevet Major-General A. B. DYER,
Chief of Ordnance:

SIR: I have commenced putting in the coffer-dam for the erection of the dam wall below the old dam, and am making good progress with it. The $60,000 which have been assigned to this object will not probably build more than 600 to 700 feet of wall, after making all necessary preparations. But if Congress shall appropriate $80,000 more, as I understood it likely would do, and have learned indirectly that it has done, it will build 1,500 to 1,800 feet of wall altogether, and it will be much more economical to build the coffer-dam all at once than at two separate operations. I therefore request that you advise me whether or not Congress has appropriated any additional funds for this purpose, and if so, how much, so that I may know how far down to extend the coffer-dam. I do not, of course, contemplate using any money appropriated at the present session of Congress prior to the 1st of July.

As I shall probably be as far down with the coffer-dam as the $60,000 will build the wall before I can hear from you by mail, please telegraph me on receipt of this whether to go on or not.

T. J. RODMAN,
Lieut. Col. Ordnance and Br'v't Brig. Gen'l.

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, June 20, 1868.

B'v't Brig. Gen'l T. J. RODMAN,*
Com'd'g Rock Island Arsenal:

SIR: I have to acknowledge your letter of the 15th inst., and, in reply, to inform you that the Army appropriation bill for the fiscal year ending June 30th, 1869, has been

* The exact cost of particular water-power constructions built at this time cannot be determined accurately. Work on this wall, the island earth dike, the stone dike, the canal and wing-dam were carried on simultaneously, and, although an account of expenditures on the water-power was carefully kept, the cost of the different parts of the work was not kept separately.

enacted into a law, and the following is one of its provisions: "For arsenal and armory at Rock Island, Illinois, three hundred and eighty thousand dollars: *Provided*, That eighty thousand dollars of said sum shall be devoted to the development of the water-power, to carry out existing contracts."

The money will be available after the 30th instant, and you are authorized to make your arrangements accordingly.

Respectfully, your ob'd't serv't,

A. B. DYER,
B'v't Maj. Gen'l, Ch'f Ord.

MOLINE, *June* 30, 1868.

B'v't Brig. Gen'l T. J. RODMAN,
Rock Island:

SIR: The Moline Water-Power Company would be accommodated if you would have your coffer-dam extended (down stream) from one to two hundred feet beyond the 1,500 feet which you proposed would be sufficient for the purposes of the Government, and will pay for such excess; and if you will then have it run obliquely to the shore instead of perpendicular, they will pay the cost of the additional length.

Very respectfully, your ob'd't serv't,

CHAS. ATKINSON,
Pres't M. W. P. Co.

General Rodman changed the location of the coffer-dams, as requested.

MOLINE, *July* 1*st*, 1868.

B'v't Brig. Gen'l T. J. RODMAN,
Rock Island Arsenal:

SIR: By the terms of the contract and transfer of the fee of the Moline water-power to the United States, no definite or specified time for the full development of the water-power was given, the complete development of the power which we understand to be contemplated by the Government will necessarily require considerable length of time, even if work should progress continuously upon it, and in view of the uncertainty of appropriations of money for that purpose, it will in all probability be several years before the development of the power will be completed, and, consequently, before this company can avail itself of the power, unless a bulk-head similar to the old one should be thrown across to the island shore from the lower end of the wall you propose to construct this year.

As I have remarked, no time was fixed by the transfer for complete development, yet it was understood by this company, and we cannot doubt it was the intention of the Government, to so adjust the process of development of the water-power as to furnish this company its quota under the contract with as little delay or damage by hinderance of their operations as would be consistent with the character and stability of the work. It will be perceived that the new wall will be useless to us without a new bulk-head, (at least for a long time,) and you are doubtless aware that the old bulk-head has become so dilapidated and worn-out, that it cannot reasonably be calculated on to stand another season of high water, and, knowing the dependence of our community on the water-power, can readily appreciate the interest this company feel in knowing the purposes of the Government in regard to making the water-power available to us, as far as the wall is built the present season. It has occurred to this company that your orders pertaining to this work may not give discretionary power to make a decision of the matter in question; if not, you will confer a favor on us by referring it to the War Department, asking early attention, as the season is advancing in which this kind of work has to be commenced, if done this season. Be pleased, general, to give us an early answer to this communication.

I am, very respectfully, your ob'd't serv't,

CHAS. ATKINSON,
Pres't M. W. P. Co.

This letter was submitted to the Chief of Ordnance, and his instructions in the case requested. The following is his reply:

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, July 7, 1868.

B'v't Brig. General T. J. RODMAN,
Rock Island Arsenal:

SIR: I have received your letter of the 3d inst., in relation to the development of the water-power at the head of Rock Island under the appropriations for that purpose,

with that from Mr. Atkinson urging the immediate construction of a bulk-head similar to the old one. Neither the proceedings of the Rock Island commission nor the appropriation acts make any mention of the *order* in which the works for the development of the water-power should be undertaken. It is understood, however, that the interests of the United States shall govern in this matter, and beyond this I am not authorized to give instructions on the question presented by Mr. Atkinson. I will, however submit such views and opinions and arguments as you and Mr. Atkinson may send to this office to the Secretary of War for his decision in the matter, and communicate it to you when received, for your information and government.

Respectfully, your obe'd't servant,

A. B. DYER,
B'v't Major-General, Chief of Ordnance.

The substance of this letter was communicated to the Moline Water-Power Company.

In the fall of 1868 a controversy began with the Moline Water-Power Company on various matters relating to the Moline water-power, as shown in the following correspondence, which finally led to a new agreement with that company and a considerable change in the plans for the water-power.

The new arrangement was executed in the following April, (1869,) and the change of plan was to what was called the canal plan, heretofore described, and shown on the map on Plate XI.

On the 5th of October, 1868, General Rodman wrote to the Chief of Ordnance as follows:

ROCK ISLAND ARSENAL, *October 5th*, 1868.

B'v't Major-General A. B. DYER,
Chief of Ordnance, Washington, D. C.:

SIR: I find in carrying into practical effect the contract between the United States and the Moline Water-Power Company, including the recommendation of the commission appointed under the acts of Congress approved April 19th, 1864, and June 27th, 1866, the following points, which seem not to be clearly understood by the parties in interest, and which ought, in my judgment, to be definitely settled and understood while the parties to said agreement and the commissioners who made the recommendations are still living and accessible, viz:

1st. To what extent are the United States to develop the water-power conveyed them by the Moline Water-Power Company? Are they to clean out and deepen the tail-race or outlet for the water used by the company? Are they to put in a temporary bulk-head, to enable the water-power company to use its share of the power that would be thus developed, pending the complete permanent development by the United States of the entire water-power? And in case the company shall be permitted to and does put in such bulk-head, shall it be required to remove it when the United States shall require its removal? Are the United States to put in gates for opening and closing the water-way left in the permanent stone dam for use of the company?

2nd. In article 1st of the agreement between the United States and the Moline Water-Power Company, that company conveys in fee to the United States of America their entire water-power.

In article 3d of said agreement, the United States of America grants to the Moline Water-Power Company the right of the free use of one-fourth of their entire water-power above conveyed.

Article 4th of said agreement states it to be "further understood that this agreement is for the purpose of carrying out the recommendations of the commissioners appointed under the acts of April 19th, 1864, and June 27th, 1866, relative to the water-power company and water-power at Rock Island, Illinois, and that the recommendations of said commissioners, now on file in the War Department at Washington City, are regarded as part of this agreement."

The commissioners above referred to, in article 3d of their recommendations, recommend that the Moline Water-Power Company shall have the use in perpetuity, free from all charge for rents or repairs, of one-fourth of the entire water-power developed. The United States took possession of, paid for, and now own the water-power developed and formerly owned by D. B. Sears. This water-power is supplied with water from the same pool as the Moline water-power, and the same works that develop one develop the other; and Mr. Sears informs me that he always considered that he was entitled to half of the water that came into the common pool.

Now, the questions growing out of the point above stated are:

1st. What was the true intent and meaning of the expression, "one-fourth of the

entire water-power developed," used by the commissioners? Did it mean that the Moline Water-Power Company was to have one-fourth of the Sears water-power, in addition to the one-fourth of that conveyed by the company to the United States? Or did it mean that the company was to have one-fourth of the entire power which they had conveyed to the United States after it had been developed by the United States, in whatever manner or to whatever extent? Or did it mean that the company was to have one-fourth of the entire power which they had conveyed as it should be developed by the United States in the vicinity of their works? In other words, in what manner is the quantity of water which the company is to have to be determined?

3d. The United States have granted to the Water-Power Company "the privilege of renting for a specified time, at the rate of fifty cents per annum per square inch, so much additional water-power as the Secretary of War may deem it expedient to authorize to be rented," and also agrees to arrange the Government works for developing the water-power in such manner as to enable the Moline Water-Power Company to avail itself of the right and privilege above mentioned.

In locating the permanent stone dam as far down below the company's works as will enable them to draw off and use their portion of the power, I have so placed it as to leave the company full one-fourth of the bed of the river for the escape of their tail-water.

In extending the dam down stream, it will be necessary, should the Secretary of War deem it expedient to rent additional power to the company, to so locate as to give increased water-way for the escape of the increased amount of water that would be used by the company in proportion to the amount of power so rented and used. But should the United States so locate their dam, it will so contract this water-way as to deprive them of the ability to use their entire water-power when they may desire to do so, and when it may be of the utmost importance that they should do so. This is on the supposition that the development of the water-power is effected by extending the stone-dam down the bed of the river to the point (1) on the accompanying plan, on the island shore, where the United States will take off their power.

Another mode of development, and one which I prefer, if it can be effected at about the same cost, is to curve the dam to the left as it extends down stream, and abut it against the Illinois shore at the point (2,) and cut a canal from this point across the tongue of land to the point (3) for the escape of the company's tail-water, and building a dam wall with a sufficient number of water-ways in it to take off the entire water-power, including the company's share thereof, when required, from the point (1) on the island to the point (4) on the Illinois shore.

This canal would save the building of about 1,500 feet of stone dam, and if made 200 feet wide would, it is estimated, cost about the same sum of money as the 1,500 feet wall.

The conformation of the river at this point is such that by this mode of development, and increasing the width of the canal, the United States might, if deemed expedient, rent a very considerable amount of power, when not required, and still be able to resume the use of their entire power at the point (1) when required, together with that of the company, should the exigencies of war ever render it necessary or desirable to do so.

It is agreed in article 4th of agreement between the United States and the Moline Water-Power Company that neither of them shall at any time make any obstruction of the water-power as now existing or hereafter developed.

Does or does not this article exclude the "harboring in the common pool of saw-logs or other material that will tend to fill up the dam or obstruct the flow of water past the company's works on its way to the point of utilization by the United States?"

T. J. RODMAN,
Lt. Col. Ord. & B'v't Brig. Gen'l, U. A. S.

General Rodman sent this letter to Mr. C. Atkinson for his information and for such remarks as he might desire to hav e accompany it and the following letter from Mr. Atkinson was received and inclosed in General Rodman's letter to the Chief of Ordnance:

MOLINE, *October 20th*, 1868.

B'v't Brig. Gen'l T. J. RODMAN,
Rock Island Arsenal:

SIR: The communication from yourself to Chief of Ordnance, submitted to this company for information and remark, together with your accompanying note, having been received and the subject-matter considered by the directors of the company, is, in accordance with your request, and in compliance with your directions, herewith returned, with a few brief remarks, viz:

1st. Congress, having understood the nature and import of the transaction between the company and the United States, accepted the recommendation of the commission, and in accordance therewith made special appropriations of money to carry the same into effect, and this company having promptly and in good faith performed its part of the agreement, by conveying the fee of their water-power, which was accepted and taken possession of by the United States, they feel that they have no other alternative but to refer to Congress any matter of controversy in the premises that may arise between them and the War Department, relying confidently on that body to carry out the spirit and understanding of that agreement.

2nd. As to the matter of dividing the water-power: This company will hold itself in readiness at any suitable time to act with the Government in making an equitable division, but does not perceive how anything in that direction can properly be done until the power is developed; and without replying to the opinion introduced of Mr. D. B. Sears as to his rights, and by inference to theirs, they would take this occasion to say that they at all times claim, under the contract and understanding of the agreement, that they are entitled to the free use in perpetuity of one full quarter part of all the power that can be produced from the water that will pass into the pool between the island and main shore with all obstructions removed, and they expect and claim, under the contract, that the United States should arrange its works as well with reference to renting water-power, as to that which the company has a right to use in perpetuity free of rent or repairs.

3d. Regarding plans of adapting the water-power to suit the location of Government shops on the island, it is not expected, and they deem it somewhat out of place at this time to express any opinion on that subject other than to say they cannot consent to any arrangement to an end that will tend to impair or embarrass their rights under the agreement.

The 4th article of the agreement and the 6th article of the recommendations of the commissioners, both having reference to the same subject, is understood by this company to mean that the Government will not place or permit any substance to remain in the pool or water-way to the detriment of the water-power.

Therefore, requiring under the contract that the United States should clear out and deepen the tail-race to an extent that may be necessary to secure an easy and free discharge of the tail-water from the wheels of the company, its lessee or assigns, and also to remove the accumulations of sand, mud, or other substances in the entrance to and within the pool, so that all the water necessary to a complete and full development of the entire water-power can pass in between the island and the main shore.

In reference to the matter of bulk-head and gates at opening, it is understood by this company that when the United States accepted the fee of their water-power, and took possession of the same, it was an agreement on the part of the Government that it make and maintain all improvements, repairs, and things necessary for and pertaining to the delivery of water upon the water-wheels of the company, its lessees or assigns, without any unnecessary delay after appropriations had been made, and it is certain that the transfer and conveyance of the water-power belonging to this company would not have been made to the United States or consented to without such understanding on their part.

It is desired that this reply accompany your letter to Chief of Ordnance.

With great respect, I am your ob't serv't,

CHARLES ATKINSON,
Pres't Moline Water-Power Co.

The undersigned, directors and stockholders in the Moline Water-Power Company, fully indorse the above communication as containing their views and expressing their understanding of the subjects considered.

J. M. GOULD.
JOHN DEERE.
JOHN GOOD.
C. H. DEERE.
S. W. WHEELOCK.
J. S. KEATOR.
D. C. DIMOCK.

On November 3, 1868, the Chief of Ordnance submitted both letters to the Secretary of War, with the following indorsement:

It is very desirable that the questions at issue should be settled understandingly, and as soon as possible; and as the company seems to base its views upon the report of the commission, it is respectfully suggested, in the event of doubt on the mind of the Secretary of War as to the true meaning and intent of the commissioners, that they be called upon to declare what is the true meaning of the language used with regard to the points at issue.

On the 7th of November, 1868, Charles Atkinson, president Moline Water-Power Company, addressed General Rodman, as follows:

MOLINE, *November 7th*, 1868.

B'v't Brig. Gen'l T. J. RODMAN,
Washington, D. C.:

SIR: You will doubtless recollect remarking to me, some weeks ago, that you thought the better plan for further prosecution of work on the water-power improvement would be "to extend the lower end of the wall and excavate tail-race next season, and the next year after that finish the upper end." I have made known your views (as I understand them) to the company, and in reply am instructed to say—

That, in view of the insecure condition of the old bulk-head, (and Captain Anderson informs me that he has doubts of its even standing through another season of high water,) and of the delays, already much greater than was anticipated, in completing the improvements for our portion of the water-power, and by reason of which we have already lost chances for renting power for manufacturing to parties who have located elsewhere, thus injuring our interest and retarding our growth, and, further, that of the $80,000 additional appropriation of last winter, "to carry out existing contracts," (meaning its engagements with this company,) a part only of which is expended, they hope you will be induced to so modify your plans and arrangements as to decide to finish the upper end next season, deferring the *lower* end until afterwards. They would be pleased to acquiesce in your views, and co-operate in all your plans of improvement, but they think they see wherein it may make a good deal of difference to their interests, as a company and as individual manufacturers, whether the upper portion of the wall is completed next year or deferred to the year following, but do not perceive how it can make any special difference with the United States to finish the upper end first.

Please make known your views on the points mentioned at your earliest convenience, and oblige,

Your ob't serv't,

CHARLES ATKINSON,
Pres't M. W. P. Co.

To which, under date of December 23d, 1868, General Rodman replied as follows:

ROCK ISLAND ARSENAL, *December 23d*, 1868.

CHARLES ATKINSON, Esq.,
Pres't Moline Water-Power Co.:

SIR: Your letter of the 7th inst., and which was received at Washington City just before I left there, was received here, with other papers, this morning. In reply I would state that I am not now prepared to give definite answers to the points made in your letter, further than to say that the course of improvements of the water-power therein proposed will be considerably more costly to the United States than the one I had proposed to follow.

The questions which I referred to the Secretary of War, in my letter of the 5th of October last, together with that as to the terms on which the water-power company will allow the United States to use so much of the company's land as may be necessary for a canal for company's tail-water, and to abut their dam against the company's land at upper end of proposed canal, and at the point of development of power used by the United States, should all be acted upon and definitely settled before running this work next season; and to this end, and for the determination of the question as to whether the canal mode of development of the water-power shall be adopted, I request that you will advise me of the terms on which you will allow the United States to use so much of your ground as may be necessary for a canal to carry off your company's tail-water. Also, the terms on which you will cede to the United States the right to abut their dam against your ground, both at the upper end of the proposed canal and at or near the point of utilization of their power by the United States.

An early reply is requested.

Very respectfully, your ob'd't serv't,

T. J. RODMAN,
Lt. Col. Ord. & B'v't Brig. Gen'l.

The following answer was received thereto:

MOLINE, *December 28*, 1868.

B'v't Brig. Gen'l T. J. RODMAN,
Rock Island Arsenal:

SIR: Your verbal request to me a few days ago that the Moline Water-Power Company would indicate the terms upon which the United States might have the right of

way for a tail-race across their land, and abut the proposed dam and wall against their shore, together with your letter of the 23d inst. referring to the same subject, have both been presented to and considered by the directors of this company; and as it is understood by them that a definite proposition would contemplate the lower end of the water-power improvement to be made next season, and the upper end in which they have more direct interest to be delayed to some future time, I am instructed to reply that, in view of the insecure condition of the old dam and bulk-head, and of the very great probability that it will not stand, even through another season of high water, and of the positive damage to the company by additional delay, that they are not now prepared to make definite propositions to the United States that would tend to defer the development of that portion of the water-power they are entitled to the use of to a point beyond next season.

That they would be happy to acquiesce in all views and plans tending to the best development and improvement of the water-power, and also to lend their aid to secure all needed appropriations; and that in the matter of granting the right of way for the tail-race, and abutting the dam and wall against their shore, they propose to act in the spirit of fairness and liberality, but their interests at stake are of such character and magnitude they cannot willingly consent to the postponement of the completion of the upper portion of the wall beyond next season; and although it is possible the lower end may cost a very little more if not done first, yet the Government of the United States having accepted conveyance of the company's property, and in consideration thereof agreed to make certain improvements for the benefit of said company, it seems to them that it is incumbent on the Government, acting in the spirit of equity and good faith, to proceed first to put that portion of the water-power to which the company is entitled to the free use of (free of rent or repairs) into a condition for permanent and safe enjoyment and use by them or their lessees.

That such was the intention of Congress in making the appropriation of $100,000, in accepting and approving the recommendation of the commission, and in making the additional appropriation last winter of $80,000 "to carry out existing contracts."

It is now nearly three years since this matter has been under consideration, and nearly two years since the agreement was signed on the part of the company, conveying its property to the United States, and the subsequent delays that have occurred are not by any fault or neglect of theirs. It will also be borne in mind that this company have been deprived of the benefits of their improvements on the island end of the dam, with, as yet, no corresponding or increased facilities for renting or using, or renting power on the Moline side; it seems, therefore, a peculiar hardship to be required or expected that they should wait longer than next season in order to have their portion of the water-power put into condition for permanent use. As to its being more costly if the lower portion of the work was deferred to a time after next season, it would seem that, under the most favoring circumstances, it can hardly be expected that the Government portion of the water-power can be got ready and applied to machinery in the Government shops in less time than from three to five years, and that the probable cheapening in the price of labor and material in that time will more than compensate for the increased cost as suggested in your letter; but, however this may be, it is not felt or understood by this company that the interests of the Government in this matter are to be regarded as paramount and theirs contingent and incidental.

As suggested to the Chief of Ordnance in your letter to him in October last, "that there were points in the agreement not clearly understood by the parties in interest," and as from present indications frequent questions are likely to arise for consideration and adjustment, this company, desiring to act in the spirit of equity and to promote harmony, would propose an early settlement of all outstanding questions, as far as the same are practicable; or if it is deemed that it will better subserve the interest of the Government and avoid further complications, they are willing, if it is desired, to adopt your suggestion of considering the question of selling their entire interest to the Government and of paying stipulated annual rent for water-power.

As before mentioned, it is the cordial desire of this company to co-operate and act in harmony with the Government in all that pertains to the best and fullest development and use of the water-power, but, as also observed, it is a matter of so great interest and importance to them that their part of the power be fitted for safe and permanent use, and, as it would seem to be of so little consequence to the Government which part of the work was done first, it is most sincerely desired that you agree to the plan proposed of completing the upper end of the work next season.

With great respect, I am, your ob'd't servant,

CHAS. ATKINSON.
Pres't M. W. P. Co.

The following is General Rodman's reply to the above:

ROCK ISLAND ARSENAL, *January 2nd*, 1869.

CHARLES ATKINSON,
President of Moline Water-Power Company:

SIR: Yours of the 28th ulto. is received. In reply I have to state that I did not contemplate that the settlement of either of the questions referred to in my letter of the 23d ult., or of the terms on which your company would cede to the United States the right of way for canal for tail-water, and the right to abut their dam against the company's land at the two points named in my letter above referred to, should have any influence in determining the point at which work should be resumed next season on the development of water-power.

I would, however, repeat that, in my judgment, it is important and proper that all of these points should be determined and definitely settled before the resumption of work at *any* point on the development of the water-power.

As to the point at which work shall be resumed on the improvement of water-power after the points above referred to shall have been settled, it will be my duty to begin at that point which, in my judgment, will be the most advantageous to the United States, unless otherwise directed by proper authority.

I would also state that in full reciprocation of the "cordial desire of your company" for harmonious action between them and the United States, and believing that a sale to the United States on fair and equitable terms by your company of their entire interest in the water-power would tend to promote such harmonious action, I request that you will, at your early convenience, advise me of the terms on which your company will agree to make such sale.

I am, respectfully, your ob'd't serv't,

T. J. RODMAN,
Lt. Col. Ordnance, B'v't Brig. Gen'l, U. S. A., Commanding.

To which the following answer was received by General Rodman:

MOLINE, *January 9th*, 1869.

B'v't Brig. Gen'l T. J. RODMAN:

SIR: Understanding by your letter of the 2nd inst. that your letter of the 23d ult., asking the terms on which the Government could have the right of way across this company's land for a tail-race, and the right to abut their dam and wall against the shore, was not intended to have any influence in determining the point at which work would be resumed next season, I am authorized to say that if the Government will complete the upper end of the work next session, so that this company can use their quota, and will pay the expense of continuing to completion the excavation of company's tail-race as begun last season, they will grant, free of cost, the right of way for tail-race of sufficient capacity to carry off company's tail-water, (together with what they may rent of the Government additional,) and will also cede to the Government the right to abut their dam and wall on the company's land, with proper restrictions as to overflow, &c.

I am further instructed to say that, fully appreciating your suggestions as to the determining of unsettled points, they propose that you name a time and place of meeting, with a view to consider, and, as far as practicable, adjust and settle *all* matters between them and the Government pertaining to improvement, use, and joint occupancy of the water-power; and they express the hope that all outstanding questions may be disposed of, and that it will, in your judgment, better subserve the interest of the Government to finish the upper end of the work next season than to take the risk of the damage that may accrue to the company by a longer delay.

In reply to your request that this company would advise you of the terms upon which they will agree to make sale to the United States of their entire interest in the water-power, I am also instructed to say that, retaining in perpetuity the use of 24-100 inch wheels, or its equivalent, and pay thereon at the rate of 50 cents per inch per annum, to commence paying as company use water, the right as now to rent further quantity, the upper end to be done next season, and company to be paid for the further expense of excavation tail-race, they feel that the Government should pay $160,000 and supply S. W. Wheelock, free of rent, the 1,600 inches of water heretofore released by company; and in consideration they would propose to transfer to the Government their entire interest in the water-power, together with right of way for tail-race, and cede the right to abut their dam and wall against company's land, with suitable restrictions as to overflow and disposition of material from tail-race.

With great respect, I am your ob'd't serv't,

CHAS. ATKINSON,
Pres't M. W. P. Co.

General Rodman replied as follows:

ROCK ISLAND ARSENAL, *January 9th*, 1869.

CHARLES ATKINSON,
President Moline Water-Power Company:

SIR: Yours of the 9th inst. relative to water-power is received. In reply I have to state that the unsettled questions between your company and the United States referred to in my letter of the 23d ult. having been referred to the Secretary of War, I cannot, without further instructions, take further action upon them.

You have given, in your letter above referred to, the terms, coupled with other conditions, on which your company will agree to cede to the United States the right of way across their land for canal for company's tail-water, and the right to abut the United States dam against the company's land at upper end of said canal and at the lower point of development of power to be used by the United States.

I request that you will also give me, at your early convenience, the terms on which you will agree to cede those privileges to the United States, uncoupled with any other conditions.

I am, respectfully, your ob't serv't,

T. J. RODMAN,
Lt. Col. Ord., Bvt. Brig. Gen'l, U. S. A., Commanding.

The following was received in reply to the above:

MOLINE, *January* 13, 1869.

B'v't Brig. Gen'l T. J. RODMAN:

SIR: Your letter of the 9th inst. is received, and has been considered by the board of directors of this company, and in reply they direct me to say that their recent propositions were deemed to be an answer to your communication, and to your wishes as expressed in the recent personal interview at your office between yourself and them; but they did not then, and do not now, understand an interpretation of the contract between this company and the United States to mean, or to require, that further propositions from them were necessary in order that the obligations assumed by the Government under the agreement should be carried out.

The pecuniary compensation they would expect to receive from the Government for the right of way for a tail-race and abutting the dams against their land is of small importance to them compared to an improved and safe condition of that portion of the water-power which specially and vitally pertains to their interests.

In view of the unsatisfactory condition of affairs growing out (as they feel) of the unwarrantable delay of the Government in carrying out the spirit of the contract and agreement under which it received the title to the water-power; of the opinion expressed, that the interests of this company were held to be as of minor consideration, and subordinate to the interests of the Government in matters pertaining to the water-power; of the continued expense, detriment, inconvenience, and loss to which they feel this company unnecessarily subjected; and of the uncertainty of their future at the hands of the Government, they would most respectfully (and with all proper deference to your request) suggest, that it would seem unwise and injudicious to them to make further propositions until better informed as to the purposes of the Government concerning the completion of the improvements of their portion of the water-power; and would add, that their views of their rights and of the obligations assumed by the United States under the contract remain as expressed in my letter to you under date October 17, 1868.

As stated in your letter of the 9th inst., that "the unsettled questions between this company and the United States having been referred to the Secretary of War," and that you "cannot, without further instructions, take further action upon them," and this being regarded as suggestive intimation of *their* proper course, this company in reply would say, they propose at an early day to refer the matters in question to the Secretary of War or Congress, in the hope of satisfactory adjustment. With assurances of respect,

I am your ob'd't servant,

CHAS. ATKINSON,
Pres't M. W. P. Co.

Gen'l RODMAN:

The undersigned desire to say that the foregoing expresses our views and feelings of the questions between the Moline Water-Power Company and the United States, as we understand them, and we feel that no further proposition ought to be made or expected

until we know with certainty the intentions of the Government as to improvements directly affecting our interests and business.

We are content with the present agreement, and can do no less than insist that it should be carried out as between man and man.

J. M. GOULD.
J. S. KEATOR.
D. C. DIMOCK.
JOHN GOOD.
S. W. WHEELOCK.
C. H. DEERE.
JOHN DEERE.

On January 25th, 1869, Brevet Major Parker, in temporary command of the arsenal, wrote General Rodman, then in Washington, as follows:

GENERAL: Captain Anderson informs me that Mr. Atkinson desired him to ask me whether or not the Government intends to repair the dam opposite Wheelock & Co.'s mill, and that he also stated that if I refused to do so, he (Mr. Atkinson) would have it repaired, and charge the cost of same to the Government, as he considered the mill-property in danger from the spring high water with the dam in its present condition.

Capt. Anderson also tells me that your attention was called to it, and that you are fully informed in the matter.

I therefore refer to you for directions.

* * * * * * *

Pursuant thereto, General Rodman, under date of January 28, 1869, gave the following instructions to Major Parker:

Yours of the 25th inst., relative to repairs of dams opposite Wheelock's mill, is received. I do not know, from your letter, whether the point of dam referred to is at the island end of the dam or at the other side, immediately contiguous to Wheelock's mill. This last-named point I did not examine when last at my post; the other point I did look at, though not so carefully as to say whether or not it was safe. Please examine both of these points, and make such repairs as will, in your judgment, secure them against the action of high water. Brush and rough stone should be used, if required, near Wheelock's mill, and crib-work, filled with rough stone, at the island end. The stone in the piers of the old bridge may be used for this purpose.

* * * * * * *

In accordance with their letter to General Rodman, of January 13th the Moline Water-Power Company addressed the Secretary of War as follows:

MOLINE, *January 27th*, 1869.

Hon. J. M. SCHOFIELD,
Secretary of War, Washington, D. C.:

SIR: I am instructed by the board of directors of the Moline Water-Power Company to call your attention to the condition of matters between this company and the United States, under the contract and agreement by which they conveyed to the Government the fee of the entire water-power.

It will be recollected that the company had been subjected to disappointment and delay from the date of the appropriation of the $100,000, in February, 1866, to June 19th, 1867, the time they signed the contract. It was understood then that there would be no further delay, but still there was delay, and the contract was not executed, on the part of the United States, until August 20th, 1867, too late, in the opinion of General Rodman, to do anything that season, so that another whole year was lost to them.

Last season the work was commenced, and some 1,300 to 1,500 feet in length of dam-wall was built, but it does not connect with the old wall, and is not, therefore, of any practical or possible use in furnishing power to this company until it is connected, and is not an extension of the lower wall, as is contemplated in the contract.

Gen'l Rodman has indicated to this company that, for the interest of the Government, it will be better to extend the wall down stream next season, and complete the lower end of the work first, and leave the upper end of the work to be completed afterward; and has notified the company that all questions as to future improvement are referred to the Secretary of War, to which we most cordially assent.

We do not, however, understand that Government interests in this matter should be held paramount to the interests of the company, as would seem to be the understanding of the Ordnance Department, by a letter from Gen'l Dyer to Gen'l Rodman, under date July 7th, 1867.

This company disclaims any desire or intention to be captious or unnecessarily particular, but having in good faith conveyed their water-power to the United States, they certainly must have the right to demand that a like good faith should be exercised toward them, and that there should be no unnecessary delay in carrying out the understanding and stipulation of the agreement in furnishing to them one-fourth part of the water-power developed. By reason of these delays this company has not been, and is not now, able to give any satisfactory assurances to persons wanting to rent power when they can be accommodated, thereby working a positive damage to its interests much greater than it can be to the United States to furnish at once the quota of power to which it is entitled.

The present dam and bulk-head are so dilapidated as to have become very insecure. If they stand through another season of high water it is all that can be expected, and even if they should stand, the leaks are so large that the tail-race is flooded so much that it greatly impairs the efficiency of the wheels now in operation.

Another reason why there ought to be no further delay, the Government required persons on the island end of the dam to leave the premises, thereby depriving the company of an income from water-rent of nearly $2,000 per annum, and as yet have made no improvements as an equivalent where water can be used, so that practically they are worse off for power than before; and in view, therefore, of their interest, they cannot consent to any further delays or to any arrangement that will tend to increase suspense or withhold benefits to which they are entitled, unless the United States will agree to respond to all damage they may sustain by delay.

They believe the appropriation of $80,000 by the last Congress to carry out existing contracts should be expended in conformity with the intention of Congress, and would therefore respectfully ask an order of the War Department, to the end that the agreement with this company be carried out without further delay; or if other views should obtain in the premises, to make it known at an early day, so that application can be made to Congress for such additional legislation as may be deemed necessary.

With great respect, I am your ob'd't servant,

CHAS. ATKINSON,
Pres't M. W. P. Co.

The following letter to the Secretary of War gives General Rodman's plan for the settlement of the disputed points:

WASHINGTON, D. C., *February 16th*, 1869.

General J. M. SCHOFIELD,
Secretary of War:

SIR: In obedience to your verbal instructions, and after having read and carefully considered the recommendations of the board of commissioners, and the agreement between the United States and the Moline Water-Power Company, explanatory of and for carrying into effect said recommendations, together with letters of Selden M. Church, dated January 20th, 1869, and James Barnes, dated January 25th, 1869, (said Church and Barnes having both been members of said commission, and said letters being explanatory of their views and understanding as to the true intent and meaning of the recommendations of said board of commissioners, looking to an agreement to be entered into between the United States and the Moline Water-Power Company,) I have the honor to submit the following as my views of the equity of the case.

1st. The United States having already complied with their obligation to the Moline Water-Power Company as to the development of *wing-dam*, are yet to extend the stone dam so as to enable the company to utilize their portion of the water or water-power, including that which the Secretary of War shall deem expedient at any time to rent to the company; to remove the old dam and other deposits of sand, mud, &c., from the pool above the old dam, and to close the water-ways in said dam with gates, for retaining the water in the pool or letting it through the dam at will; the company to deepen their own tail-race, and put in temporary bulk-head, should they so desire, at their own cost; and remove it, when so required by the United States after the complete development of the water-power by the United States.

2nd. The water coming into the common pool to be divided between the Sears water-power and the Moline water-power in the ratio of the width of the channel between Benham's Island and Rock Island to that of the channel between Rock Island and the Illinois shore at the site of the company's old dam; the company to be entitled to the use in perpetuity, free of charge, of one-fourth part of the water or water-power thus allotted to the last-named channel after it shall have been developed by the United States in the manner hereinbefore stated.

3d. The location of the stone dam is believed to be fair and equitable, and should, therefore, be approved.

4th. Neither the United States nor the Moline Water-Power Company has the right

to, in any manner, obstruct the flow of water in or fill up the pool to the detriment of the other.

5th. If the Moline Water-Power Company will grant to the United States, free of charge, the right of way for a tail-race to carry the company's tail-water across the company's land, and the right to take and use such portion of the excavated material from said race as the United States may require for diking the shores of the pool to prevent overflow of the company's land, and of Rock Island; and the right to transport said material across and over the company's land, and the right to abut the United States dam against the company's land at the upper end of said tail-race, and at another point opposite or near to that on the island of Rock Island, at which the United States may utilize their portion of the water, then the United States shall commence the further development of water-power as soon as the stage of water will permit, and at such point along the line of development as the company may indicate; and prosecute said development, including removal of old dam and bulk-head, and deposit of mud, &c., above old dam as rapidly as the stage of water and the funds on hand, and that which may hereafter be appropriated and made applicable to that purpose, will admit.

The increased cost to the United States of developing as desired by the company, and the advantages to be derived by the company and the United States from the canal mode of development, seem to me to render the last proposition just and fair.

Very respectfully, &c.,

T. J. RODMAN,
B'v't Brig. Gen'l, U. S. A.

The act of Congress approved March 3, 1869, made an appropriation for the Rock Island arsenal, as follows:

AN ACT making appropriations for the support of the Army for the year ending June thirtieth, eighteen hundred and seventy, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, out of any money in the Treasury not otherwise appropriated, for the support of the Army for the year ending the thirtieth of June, eighteen hundred and seventy:

For repairs and improvements of armories and arsenals.

For arsenal and armory at Rock Island, Illinois, one million dollars: *Provided,* That one-half of this amount shall be applied to the construction of the bridge connecting Rock Island with the cities of Rock Island and Davenport.

One hundred and fifty thousand dollars of this appropriation was applied to the development of the water-power.

On the 13th of March, 1869, General Rodman wrote to the Chief of Ordnance as follows:

ORDNANCE OFFICE, WAR DEP'T, *March* 13, 1869.

B'v't L't Col. T. J. TREADWELL,
In charge of Ordnance Bureau:

SIR: Referring to my letter of the 5th of October, 1868, the points therein referred to being still unsettled, and General Schofield, who was chairman of the Rock Island commission, having left the War Office, I would respectfully suggest that he be requested to furnish to your office a written statement in full of his views and understanding as to the points set forth in my letter above referred to. The views of the other two members of the commission are on file in your office.

I am, very respectfully, &c.,

T. J. RODMAN,
B'v't Brig. Gen'l, U. S. A.

The Chief of Ordnance referred General Rodman's letter to Major-General Schofield, and the following reply was received:

WASHINGTON, D. C., *March* 17, 1869.

B'v't Lieut. Colonel T. J. TREADWELL,
In Charge of Ordnance Bureau:

SIR: I have considered General Rodman's letter of the 13th inst. which you referred to me, and have to make the following statement as to my understanding of the report of the Rock Island commission on the subject of the Moline Water-Power Company.

The United States are *not* to deepen the tail-race for the portion of the power to be used by the Moline Company, and are *not* to put in any temporary bulk-head for the company.

If the company put in one, they (the co.) should remove it when the permanent dam is completed.

Gates would seem to be a part of the permanent dam, and (unless otherwise specified in the contract) should be put up by the United States.

The "one-fourth" to which the company is entitled does *not* include any part of the water-power purchased of Mr. Sears. The company is entitled to one-fourth of the water-power which may be developed *between Rock Island and the Illinois shore.*

The dam should be so located that (as a general rule) the distances of any point of the dam from the two opposite shores may be proportionate to the quantities of water to be discharged above and below that point.

Article 4 prohibits either party from harboring logs in the pool to such extent as to obstruct the free flow of water to the portion of the dam used by the other.

Very respectfully, your obed't servant,

J. M. SCHOFIELD,
Major-General.

On the 30th of March, 1869, General Rodman wrote to the Moline Water-Power Company as follows:

GENTLEMEN: I am directed by the Secretary of War to request that you send to his office, as soon as practicable, a person fully authorized to act for your company in the settlement of questions preliminary to the resumption of work in the development of water-power at Rock Island arsenal. It is desirable that you have some one here as soon as possible, for the reason that I want to leave here at the very earliest moment that the court of inquiry shall relieve me; and this business should be settled before I leave, so that work may be commenced as soon as possible.

Yours, respectfully,

T. J. RODMAN,
B't Brig. Gen'l, U. S. A.

The new agreement was executed in Washington and sent to the arsenal by the Chief of Ordnance on the 9th of April, 1869. This agreement is copied and marked "B" in the appendix to this chapter. Soon after the receipt of this agreement at the arsenal, work on the dam was resumed and continued until the 29th of September, when an extraordinary rise of water in the river occurred and the coffer-dams were carried away. General Rodman's report of this accident to the Chief of Ordnance is as follows:

I have to report that at about 11 o'clock last night our upper coffer-dam gave way under a head of about 12 feet of water, carrying away about 200 feet of dam contiguous to the Illinois shore. This, of course, stops for the present all further progress in the building of the dam-wall and the cleaning out of deposit from the pool, the space on which we were working, between the upper and lower coffers, being now about nine feet under water.

The loss of some tools and the upsetting and breaking of three derricks is about the only damage done, except to the coffers, and they are so far damaged, and the water is so high, and the season so far advanced that I do not deem it advisable to attempt further work, either on the dam-wall or the removal of deposit from pool, this season. The monthly statement of work done in September will show what has already been done.

The present has been an unprecedented season for high water. We commenced coffering against about eight feet of water in the month of June, and in the confident expectation that that was the highest water we should have to contest with; but it has been gradually rising and we have kept on strengthening and raising the dams until last night, when, as before stated, the upper dam gave way under about 12 feet head.

After this, it was found that the water rushing through the channel endangered the part of the coffers still standing and some parts of the water-power already built. It was also feared that, if the current was left unchecked, the Chicago, Rock Island and Pacific Company's railroad-bridge and Rock Island wagon-bridge would be endangered by the

breaking up of the ice in the following spring. Also, the Moline Water-Power Company were anxious to have the construction of the water-power so far completed during that fall that by putting in their wooden bulk-head (*b* on the map) the water-power would be in such condition that they could commence using it. That company could put in the bulk-head only when the coffer-dams were in and the river-bed bare of water. The cost to the United States of putting in the coffer-dams during the high water would be much greater than if it were postponed until the low water occurred in the following season.

It was proposed and urged by the Moline Company that the coffer-dams should be renewed and that that company should pay one-half the cost of the work and the United States the other half, and that whatever the Chicago, Rock Island and Pacific Railroad Company would pay should also be devoted to the work. On the 12th of October General Rodman wrote to the Chief of Ordnance and asked for authority to comply with the above request. The authority was given, and an agreement to carry out the foregoing was entered into with the Moline Water-Power Company on the 28th of October, 1869. This agreement is copied and marked "C" in the appendix to this chapter.

The work of removing the coffer-dams in accordance with the foregoing agreement was begun on the 15th of October, some days before the agreement was finally signed. Mr. S. W. Wheelock, of Moline, superintended the work on the part of the Moline Water-Power Company, and Captain Morris Schaff, Ordnance Department, United States Army, then stationed at the arsenal, was in charge of the work on the behalf of the United States.

On the 22d day of November, 1869, the coffers had been completed, the water pumped out, and work on the wall was renewed. The wall was then completed in December of the same year, all except about 100 feet at the lower end, heretofore mentioned, which was not built till 1871 and 1872.

The Moline Water-Power Company put in their wooden bulk-head, marked "*b*" on the map, by which the dam-wall was connected with the shore of the island in November and December, 1869. The coffer-dams were not taken out until the following spring, and the Moline Company commenced using the water-power in August, 1870. It has been used by that company almost continuously ever since.

There was a good deal that was interesting connected with the coffer-dams mentioned in the foregoing history. When they were first put in, in the summer of 1868, their location was as follows: The lower coffer was placed across the channel just below the site of the wooden bulk-head, marked "*b*" on the map. The upper coffer was on the line of the Moline Company's old dam, and portions of this dam were strengthened and used to form part of the coffer. A portion of this old dam had been washed out and carried away in the spring of 1868, at the same time that the old wooden bridge from Moline to the island and the old wooden bridge from the city of Rock Island to the island were carried away. This washed-out gap was filled with a coffer; there was then included between the upper and lower coffer all the site of the dam-wall except a small portion of the upper end, and the water was pumped out and the work commenced. When the piece at the upper end had to be built, an entire new coffer was built across the channel, about 500 feet farther up stream. This was done in the fall of 1868. The object of this was not only to "bare" the bed of the river of water where the upper end of the wall was to be built, but also to bare all the site of the Moline Company's old dam, in order that it might be removed. The

Moline Company had been very urgent about this, and there was much controversy and correspondence about it. This old dam had been altered, broken, and repaired several times, and there was a good deal of earth, timber, rock, brush, and trash in it. There was also a good deal of river sediment of mud and sand deposited around and above it. While the coffers were in and this part of the river laid bare, this old dam and the deposits were taken out by the United States. The total amount of material so taken out was 31,000 cubic yards, and the work cost $30,000. Also, advantage was taken of the time when the bed of this part of the river was bare to put in the piers for the arsenal-bridge to Moline.

The total cost of all work done by the United States on coffers for the building of the upper-dam wall was above $50,000.

The following letters are pertinent to and explain some of the foregoing statements:

MOLINE, *March* 18, 1870.

General T. J. RODMAN:

SIR: Yours of the 16th inst. is just received. I may not have stated clearly in my letter to Mr. Hawley what we desired. It was this: Our practical men think the best and cheapest way of getting in their wheels and racks is to repair the upper and lower coffers, and "pump out again;" and we wanted to know whether Government would be willing to defer taking out the coffers, and would also let us have the use of the pump until it could be done, which would require but a few weeks after the water gets low enough to go to work. We expected to do it at our own expense, but I think I added (if not I intended to as an argument in favor) that the Government were somewhat interested, as it could avail itself of dry bottom to remove any material left in the pool when the water came in.

Please favor us with an early reply and oblige,

Very respectfully, your obed'nt servant,

CHARLES ATKINSON,
President Moline Water-Power Co.

General Rodman was in Washington when the above letter was written. The matter was submitted to the Chief of Ordnance, and authority given to leave the coffer-dams in, and to permit the Moline Company to use the engine and pump as requested.

On the 23d of June, 1870, Charles Atkinson, president of the Moline Water-Power Company, wrote to General Rodman as follows:

I have just learned that the dredge is to be taken away to-day, or very soon, and I thought I would call your attention to the condition of the upper portion of the sand-bar in the pool. You may recollect I spoke to you about it since your return from Washington, and that "I thought considerable portion of it was left last season." In order to be more certain about it, I requested Mr. Brown (in charge of the dredge) to make an examination, and by his report I find that I was correct; that quite a portion of the bar is still there, and which is certain to keep out the supply of water in low stage. Mr. Brown informs me it can be dredged now without difficulty, but cannot in low water except at largely increased cost, and perhaps not at all.

As under our contract with the United States this portion of the work is to be prosecuted to completion, I thought it my duty to request that it be done now, rather than run the risk of having it delayed to a time when it will probably cost double, and perhaps be entirely impossible to do it all until another time of high water.

About this time Lieut. Charles Shaler, Ordnance Department, United States Army, then stationed at the arsenal, by direction of General Rodman, made soundings in the pool to determine the amount of the deposits and the position of the rock bottom. The results of these soundings are shown on a carefully-prepared chart. (This chart is not printed.)

On the 21st of May, 1870, General Rodman had entered into a contract with Case & Co. to dredge out the pool, and that company was employed with a dredge twenty-six days on the work, and took out 6,450 cubic yards of deposit. Lieutenant Shaler had, prior to this, in 1868, made some soundings and careful surveys to determine the amount

of water flowing in at the upper end of the pool. As the data obtained by these soundings and this survey were used at the time and for some years afterward in calculating the capacity of the water-power, they are interesting, and the report is copied here:

ROCK ISLAND ARSENAL, *Aug. 2nd*, 1868.

SIR: I have the honor to report that, in compliance with your orders, I made observations to determine "the quantity of water that flows into the pool at the upper end of the wing-dam."

It was necessary to determine the width, the average depth, and the mean velocity of the current at this point.

To get the width two men were sent into the water with a tape-line to measure it, being directed perpendicular to the dam by an observer at a theodolite, which was placed opposite the upper end of the dam.

To obtain the depth, a man entered the water with a graduated staff and took soundings every few paces, being kept on the perpendicular from the dam-head to the theodolite by an observer at that instrument. In this way seventy (70) soundings were taken. From a boat (directed by the theodolite) sixty-eight (68) were taken, and the mean of the sum of all the soundings gave the average depth.

To ascertain the velocity of the current, four floats were made by fastening paint-kegs to pine blocks a foot square, with uprights a foot in height fixed in their centers. The kegs were allowed to sink a foot and a half below the surface of the water. The pine floats, to which the kegs were attached by pieces of string, were used only to indicate the positions of the submerged kegs. A base-line four hundred (400) feet in length was measured along the shore parallel to the dam, its center being taken opposite the upper extremity of the dam. At each end of this base a theodolite was placed, the axis of the telescopes being perpendicular to the base, so that four hundred (400) feet was intercepted between them.

Two hundred feet above, two staffs were planted in a vertical plane perpendicular to the base-line. A boat, provided with an anchor, was aligned by an observer at the staffs, and directed to a point a hundred feet from the shore by an observer at the upper theodolite. The alignment having been made, this theodolite was turned perpendicular to the base as before. At a signal the four floats were carefully placed in the water. The observer at the first instrument cried "mark" as the upright on a passing float coincided with the vertical hair. The instant of coincidence was noted by an observer with a stop-watch. The moment of the passage of a float at the lower instrument was signaled and noted as before. The floats were caught by the boatmen below the lower instrument and the boat again anchored on the line of the staffs, while by turning the upper theodolite 5°, the observer directed it to a point on this line a little farther from shore than the first position.

In this way, forty-four (44) observations were taken, and the mean of their sum gave the average velocity of the current.

Finding, then, the product of the width by the average depth, and multiplying it by the mean velocity per minute, "the quantity of water that flows into the pool at the upper end of the wing-dam" per minute was obtained, and found to be 263,924.00 cubic feet.

Very respectfully, y'r ob'd't serv't,

CHARLES SHALER,
2nd Lieut. of Ord.

The stage of water in the river at the time this survey was made averaged about two feet above low water. The report does not state the fall in the surface of the water, or show what arrangements existed to cause the water to flow out of the pool; but I remember that in 1871 I examined this report while making calculations respecting the water-power, and Lieutenant Shaler told me then that the arrangements for outflow were made to produce as nearly as possible the same conditions that would exist if the water-power were in full use.

Since that time I have had made more extensive soundings and surveys of the pool and of the river above, and have used these latter in subsequent calculations.

THE ROCK ISLAND WATER-POWER CANAL.

The act of Congress approved July 15, 1870, appropriated $360,000 for Rock Island arsenal, of which sum $200,000 was designated for continuing work on the development and construction of the water-power.

Work on the water-power canal, in accordance with the agreement between the United States and the water-power company, dated April 8, 1869, (see Appendix B to this chapter,) was begun in the month of August, 1870. About this time a new controversy arose on various matters relating to the water-power, which caused a suspension of the work for a time, and finally resulted in a new agreement between the United States and the water-power company. This agreement, marked "D," is copied in the appendix to this chapter.

The whole history of the controversy is given in the following correspondence:

On the 25th of July, 1870, General Rodman, in accordance with the agreement of April 8, 1869, notified the Moline Water-Power Company that the canal mode of development had been adopted, in order that he might enter upon the lands of the said company for the purpose of constructing the tail-race.

The Moline Water-Power Company, by J. M. Gould, secretary, informed General Rodman, under date of July 30, 1870, that Mr. C. Atkinson, the president of the company, who was temporarily absent, had the entire management of the business of the company under certain instructions; that General Rodman's letter had been forwarded to him, and that Mr. Atkinson would either return or send instructions at once.

General Rodman notified the Moline Water-Power Company on August 1 that he should enter upon the lands of the company to construct the tail-race, as required by the agreement of April 8, 1869, to which, under date of August 6, 1870, Mr. Atkinson, president of the Moline Water-Power Company, replied that the company could not give the United States possession of the land until the conditions of the agreement of April 8, 1869, were fulfilled; and on the same day Mr. Atkinson wrote to the Secretary of War, and stated that he had been informed that General Rodman contemplated entering upon the company's land for the purpose of constructing a tail-race under the agreement of April 8, 1869. He did not consider that the conditions of the agreement had been fulfilled, and also that changes were contemplated which might seriously affect the interests of the company. He requested that an order be given to General Rodman to suspend action until he could get to Rock Island, when he trusted satisfactory arrangements could be made.

On the 8th of August, 1870, the Secretary of War, by indorsement on this letter, directed the Chief of Ordnance to order a compliance with the request of the Moline Water-Power Company, unless there were good reasons to forbid it.

The Chief of Ordnance inclosed a copy of Mr. Atkinson's letter, and the indorsement of the Secretary of War thereon, to General Rodman, and directed that work be suspended, and that General Rodman report his views on the subject.

Under date of August 11, 1870, General Rodman wrote to the Chief of Ordnance, as follows:

Yours of the 8th inst., inclosing a copy of a letter from Charles Atkinson, president of the Moline Water-Power Company, with a copy of an indorsement thereon by the Secretary of War, and directing me to report my views upon the subject, is received, and I have the honor to report as follows:

I do not know certainly to what Mr. Atkinson refers, in stating that he does not consider that the conditions of the agreement of April 9, 1869, (it should be April 8th, 1869,) between the Secretary of War and himself have been entirely fulfilled; but I presume he refers to what sediment still remains in the water-power pool. Nor do I certainly know to what contemplated changes he refers as likely to affect seriously the interests of the company of which he is president, but I presume he refers to the building of an embankment from the lower end of the present dam-wall to the upper end of the proposed canal, as approved by the Secretary of War last winter, instead of con-

tinuing the dam-wall down to head of canal. I have certainly completed the development of the upper end of the dam-wall, including thirty-seven openings with gates and means of opening and closing them.

I have also removed, or intended to remove, the sediment from the pool, as far as it could be advantageously done by dredging, and am now having a survey of the pool made in order to see just what amount of sediment still remains in it; and as neither the agreement above referred to nor the original agreement states to what extent sediment should be removed, I had intended to submit the survey above referred to to the Department for its decision as to whether or not the United States should further prosecute the removal of sediment from said pool.

Neither of said agreements state in what manner or to what extent the United States shall develop the water-power.

Article 4 of the agreement of April 8, above referred to, reads as follows, viz:

"This agreement to cede the land for tail-race and abutting dam and wall, free of cost, is to continue but two years from this date, and the United States Government is to have the right to enter upon the premises for the purpose of going on with the work any time within the two years, by notifying the company that the canal mode of development has been adopted, and upon the completion by the United States of the conditions herein named as to said upper portion, this company binds itself, its successors, and assigns, to cede and convey to the United States the premises and privileges hereinbefore named, and also the right to discharge into the company's tail-race the surface-water from the island of Rock Island."

Now I understand the first clause of this article to authorize the United States to enter upon the lands of the company for the purpose of going on with the work of the development of water-power at any time within two years from the date of the agreement without any other condition, except that the United States were to notify the company that the canal mode of development had been adopted. The second clause of this article requires the United States to fulfill the conditions cited in article 3d of same agreement before they can claim from the company a deed to the premises occupied by the canal, but there is no time stated within which these conditions should be fulfilled.

I consider that the United States are bound in equity to develop the water-power in a reasonably substantial manner, and to a reasonable extent, and that they have the right to accomplish this end in such manner as they may choose.

On the receipt of advice from the Chief of Ordnance that an appropriation of money for the further development of water-power at this arsenal has been made by Congress, I notified the water-power company that the canal mode of development had been adopted by the Secretary of War, and entered upon the lands of the water-power company and commenced work. The work above referred to will cease, until further orders, this evening.

The season is already far advanced, the stage of water in the river and the weather are now favorable for the prosecution of this work, and every day lost will be detrimental to the public interest.

On the 8th of August, J. M. Gould, secretary of Moline Water-Power Company, wrote to General Rodman:

I could not find a majority of the members of the water-power company this p. m., consequently cannot give you any permission to proceed. Messrs. John and C. H. Deer and myself agree that, in our opinion, 175 feet in width for your proposed canal-run will be too narrow for the purpose intended.

I find also that there are other important items of disagreement between us which will necessarily need a full meeting of our board, after which a conference can be had with yourself, which I fully believe now can be accomplished as soon as Wednesday, 10th inst.

On August 9, 1870, General Rodman replied as follows:

Yours of the 8th inst. is received. In reply I have to state that I claim to have entered upon the land owned by your company and to now occupy it in behalf of the United States by virtue of and in accordance with the agreement between the Secretary of War and president of your company, dated April 8th, 1869, and for the purpose of prosecuting work on the development of the United States water-power. I have already expended some public money on this work, and the public interest requires that it should go on now. It therefore becomes my duty to, and I shall continue to, occupy the ground and to prosecute work thereon unless prevented from so doing by legal process.

And, as the construction of the dike for the protection of the company's lands against overflow will be a part of the work first commenced, I request that some person authorized by your company may, as soon as convenient, come upon the ground and assist in locating said dike.

To which, on August 13, 1870, the following letter and inclosure were received:

MOLINE, ILLINOIS, *August 13th*, 1870.

General T. J. RODMAN:

SIR: I have the honor to inclose herewith a copy of preamble and resolutions passed at a late hour this afternoon by the board of directors of the Moline Water-Power Company, after a pretty full and free discussion of the subject-matter therein contained.

As far as I know or am advised, the members of this company are disposed to meet all questions that may arise between it and the United States in the spirit of fairness and liberality. I am fully aware that questions affecting the interest of one side or the other may often arise, perhaps oftener than will be entirely agreeable, yet I can see no way to avoid it so long as a condition akin to partnership exists between the United States and the water-power company. I have at times thought it would be very desirable for both sides that a division be made, if it could be done satisfactorily, so that each might know his own and the relative position of the other.

I trust the action of our directors will receive at your hands your usual deliberation and kind appreciation, and that all questions and matters pertaining to the subject may be speedily adjusted to mutual satisfaction.

I am instructed to say a committee from our board will be pleased to meet you at such time and place Monday as you may indicate.

With much respect, I am, very truly, your obedient servant,

CHARLES ATKINSON,
President Moline Water-Power Company.

Special meeting of the board of directors of the Moline Water-Power Company, held at the 1st National Bank of Moline, August 13, 1870. Present, John Deere, S. W. Wheelock, J. M. Gould, D. C. Dimock, J. S. Keator, and Charles Atkinson.

On motion of John Deere, seconded by J. S. Keator, the following preamble and resolutions were unanimously adopted:

Whereas the motives and inducements of this company in making the agreement of April 8th, 1869, to cede the right of way to the United States for a canal across their lands and abutting dams thereto, were to secure the early completion and full development of the upper portion of the water-power at Moline, so that, if it should decide at its own expense to build a bulk-head from the wall to the island, it could enjoy continuous use and possession of water-power in order to supply its lessees; and

Whereas the conditions of said agreement have not been entirely fulfilled on the part of the United States; and

Whereas this company intends to continue to act in the spirit of liberality and fairness in all its transactions and dealings with the Government; and

Whereas it has full confidence that while the present commandant General T. J. Rodman has charge of the work of developing the water-power at the head of Rock Island, (in which this company has so large pecuniary interest,) not only the letter but the spirit and understanding of any and all agreements made between it and the United States will be carried out and fulfilled, but the ever-constant changes and liability to change of officers in the military department of the country and the uncertainties and complications incident to such changes make it apparent to this board of directors that in endeavoring to care for and preserve the interests of the stockholders of this company, the policy of the United States which requires fulfillment of agreements should also be their policy so far as the same can be carried out: Therefore,

It is resolved, That notwithstanding the non-fulfillment on the part of the United States Government of the agreement hereinbefore alluded to, this company is prepared to grant the United States permission to enter upon its premises upon receiving satisfactory assurances that it will be done; that its adjacent lands be properly protected; that the tail-race shall not be less than 250 feet in width on the bottom and of continuous grade with that portion of the race now being blasted out by this company; that the coffer-dams of the United States shall be so arranged as not to obstruct the use of this company's portion of the water-power, and that additional openings be made for wheels at such points as this company may direct between the lower end of the present wall and their shore upon which the same is to be abutted.

And it is further resolved, That all the agreements relating to ceding right of way, &c., free of cost, were based on the understanding that the dam wall to be continued to the shore was to be of the same character as that already built; yet this company will make no objection to change of plan that does not impair the value of its interests in the water-power.

CHARLES ATKINSON, *President.*
J. M. GOULD, *Secretary.*

On the 16th of August General Rodman acknowledged the receipt of the above letter, and in reply gave his views in full upon all the points involved. (This letter is a long one, and, as the first part of it is almost a copy of and is in substance the same as the letter on the same subject to the Chief of Ordnance dated August 11, it is not copied here.)

General Rodman said further:

If your company is willing that the United States shall resume work in accordance with the views above stated, I will advise resumption; but, if not, I shall refer your letter and inclosed preamble and resolutions, together with this reply, and such other papers as may be necessary to a clear understanding of the case, to the Chief of Ordnance, for the decision and instructions of the Department. And pending the receipt of those instructions, as work was stopped by orders from the Secretary of War, at your solicitation and on your representation that the conditions of the agreement of April 8th, 1869, had not been fully complied with, I will not resume work, nor must your company do anything to change the state of things existing between it and the United States at the date of the receipt of the order stopping work, not raising any gates, or in any way interfering with the United States water-power or the property belonging to them and being upon the company's land.

Under date of August 19th, 1870, General Rodman wrote to the Chief of Ordnance as follows:

Referring to my letter to you of the 11th inst., I now deem it proper, for the information of the Department, to forward the inclosed correspondence between the Moline Water-Power Company and myself, and to ask its early instructions as to whether or not I shall resume work on the canal mode of development of water-power; and if so, whether or not I shall make provision for the utilization, by the Moline Water-Power Company, of their portion of the water-power already developed, pending the complete development of water-power by the United States; and if so, whether or not that company shall pay to the United States the cost of making such provision. Work should be resumed at once, if at all this season.

On August 19, 1870, the Moline Water-Power Company, by Charles Atkinson, president, withdrew their objections to the United States proceeding with canal mode of development, and agreed to refer matters of difference to the Secretary of War. On the same day General Rodman telegraphed the Chief of Ordnance that the Moline Water-Power Company had withdrawn objections to proceeding with canal mode of development, and stated that he should resume work on the 20th instant. Under date of August 17, 1870, the Chief of Ordnance acknowledged the receipt of letter of August 11th, and stated that the Secretary of War and himself would be at Rock Island arsenal in September, and that he wished the subject of canal development of water-power laid aside until their arrival.

On September 13, 1870, the Moline Water-Power Company, by Charles Atkinson, president, stated that they could make arrangements with Mr. A. Sinnett for his title to the land through which it was proposed to cut the canal, but, as a perfect title could not then be had, the company could agree to cede only such title as it could then obtain, and would not relieve the United States from maintenance in perpetuity of a sufficient discharge for the company's tail-race. If the United States wished to enter upon these conditions, the company would proceed forthwith to obtain the title from Mr. Sinnett.

Under date of October 8, 1870, the Moline Water-Power Company, by Charles Atkinson, president, granted to the United States permission to enter upon and occupy that portion of the land recently owned by Mr. A. Sinnett, and included in the straight-line survey of the canal, upon the same conditions that it occupied the adjoining land of the Moline Water-Power Company, their company having obtained the title of the same from Mr. Sinnett.

The Secretary of War, General William W. Belknap, and the Chief of

Ordnance, General A. B. Dyer, arrived at the arsenal about the 1st of September, 1870, and, after a full examination of the subject, made a new agreement with the water-power company, which was intended to settle all matters in dispute. This agreement is copied in the appendix to this chapter, and is marked "D."

CONSTRUCTION OF THE WATER-POWER CANAL AND STONE DIKE.

(Marked "*q d*" on map, Plate XI.)

To understand the object of the foregoing agreement, and particularly the meaning of the last clause of the agreement, it will be necessary to examine the map on Plate XI.

The wooden bulk-head mentioned in the agreement is marked "*b*" on the map. It was built across the channel, from the island shore to the upper dam-wall, and joined to that wall just above or east of the lower or west end of the wall. (This end was not quite completed at that time; there were about 100 feet to build.) The bulk-head and wall thus formed a complete dam across the channel from the island shore to the Moline shore at the point *n*. This enabled the Moline Water-Power Company to use the water-power while the construction of the canal and stone dike *q d* were going on, provided the United States would make arrangements for the discharge into the river below of the company's tail-water from the tail-race *s s*. There was no difficulty or material expense in making this arrangement.

The lower coffer-dam, while the upper dam-wall was being built, extended clear across the channel, about 170 feet below the west end of the dam-wall. It crossed at about the point marked "*q*" on the map.

From this coffer, and joined to it at a point just north of *q*, another coffer was built, parallel to and just north of the line of the dike *q d*, (which was to be built,) all the way down to the shore of the river just below the point *d*. The site of the dike was thus coffered out from the river, the water could be pumped out, and the bed of this part of the river "bared" for work.

Then, by taking out the portion of the old coffer between the junction near *q* and the island shore, an opening was provided for the Moline Company's tail-water, from *s s*, around the end of the dam-wall, into the river below. (The lower dam *k k* was not then built.) This was the arrangement of coffers that was adopted. It was the most natural and economical arrangement, as experience showed. Arrangements had to be made, in any case, to get rid of the leakage through the bulk-head and the gates in the upper dam-wall, and of the surface-water from the city of Moline and bluffs back of it, which was shed into the tail-race *s s*.

The natural way of building the dike *q d* was to commence at its lower end *d* and build up toward *q*. As the work approached completion it would be necessary to close up the gap between the unfinished end of the dike and the unfinished end of the wall, by completing both and joining them together. While this was being done the Moline Company could not use the water-power, and it was very important to that company that the gap should be closed and the canal finished simultaneously, in order that as soon as the gap was closed the company's tail-water might flow through the canal and the use of the water-power be resumed. With a little care, the work could be so managed as to permit this without material difficulty or expense. The work was so managed subsequently, and I think the Moline Company has no cause for complaint on this score.

The arrangement of coffers described above was perfected, the water pumped out, and work on the canal begun in August, 1870. The earth excavated from the canal was used for filling the coffers. Throughout the remainder of that season the work was prosecuted with much vigor, except for a short time prior to and pending the discussion which led to the agreement of September 6, 1870.

The location and dimensions of the canal and dike were all fixed by General Rodman. Cross-sections of both are shown on Plate XII. The cross-section of the canal shows the small wagon-bridge built by the United States across the canal in 1872 for the use of the Moline Water-Power Company, in accordance with the agreement of April 8, 1869. (See Appendix B to this chapter.)

The dimensions for the canal fixed upon were as follows: the width of the canal at the surface of the ground 200 feet, and at the bottom of the canal 150 feet; the earth to slope from the surface of the ground to the rock, then a berme, and then another slope of rock to the bottom of the canal; the slopes to be such that the action of water and frost would not cause any injurious sliding or washing of the earth or crumbling and falling of the rock. The cross-section shows that not much earth was found. Rock was found generally about 2 feet under ground, and nearly the whole excavation was through tough limestone containing flint, and difficult to work.

In the cross-section of the dike there is shown a beton-core running through the middle of the dike. The dike was built, as nearly as possible, consistent with economy, of clean, loose rock, free from earth. The core was put in to prevent leakage. All the rock for the dike was taken from the canal. The sloping sides of the dike are covered with a smoothly-laid riprap wall. The dike as now finished is the handsomest and finest structure connected with the water-power. The rock taken from the canal and not used in the dike was deposited in large mounds or "dumps" on the Moline company's land near the canal, and has been used very considerably since in building roads, foundations, &c., for the arsenal. Large quantities of it have also been used in the same way in Moline and Rock Island.

The rock had to be blasted throughout, and was hauled in wagons both to the "dumps" and to the dike. A good deal of expense was incurred in maintaining roads for hauling over the rough deposited rock on the dike, movable plank ramps were required to enable the teams to get down off the dike, and another road along the foot of the dike was required for returning teams. This was the plan pursued by General Rodman in 1870, and it was continued during the following year, while the work was under my command.

I am satisfied from subsequent examination and experience that a large saving of cost could have been effected by adopting the following plan: Large boom-derricks could have been placed along each margin of the canal with booms reaching 75 feet, and the greater part of the rock hoisted out by steam-power and deposited in dumps behind the derricks. This method would have transported the rock at much less cost than the other, and would besides have saved a considerable expense incurred in blasting and breaking up large pieces to get them into shape for economical handling. With the derricks blocks of three tons weight could have been hoisted out without breaking up. Material from the center of the canal beyond the reach of the derricks could have been hauled on tram-cars to the dike with greater economy, and the tram-track would have cost less than the roads and plank ramps. For making this plan effective more ingenuity, intelligence, and close attention

would have been required than for the other, because the derricks and tram-tracks would have been interfered with by the blasting.

No difficulty of importance was encountered in the prosecution of the work until it was nearly completed, in the fall of 1871.

Capt. Morris Schaff and Capt. A. Mordecai were at different times in immediate charge of the work in 1870, and were assisted by Capt. M. L. Poland and Lieut. Charles Shaler. No dressing or finishing of the rock sides and bottom of the canal was done during this season, and only a small amount of riprapping was laid on the dike, because none of the dike was finished.

Appendixes to Chapter VI.

A.

This agreement, made between Ulysses S. Grant, Acting Secretary of War, acting under authority of the joint resolution of Congress, approved March 2, eighteen hundred and sixty-seven, for and in behalf of the United States of America, and the Moline Water-Power Company, of Illinois, by Charles Atkinson, its president, witnesseth:

1st. The Moline Water-Power Company, for the considerations hereinafter mentioned, hereby conveys in fee to the United States of America their entire water-power, with the free and unrestricted use by the said United States of so much of the bed of the Mississippi River as may be required for the further development of said water-power, which development, together with the maintenance of that power, is to be done by the United States out of the appropriation applicable to those purposes, and of any future appropriations that may be made, applicable to the same.

2nd. The United States of America hereby grants to the Moline Water-Power Company the right of the free use of one-fourth of their entire water-power above conveyed, and the privilege of renting, for a specified time, at the rate of fifty cents per annum per square inch, so much additional water-power as the Secretary of War may deem it expedient to authorize to be rented; and also agrees to arrange the Government works for developing the water-power in such manner as to enable the Moline Water-Power Company to avail itself of the right and privilege above mentioned.

3d. The United States of America hereby agrees to apply forty thousand dollars, or so much thereof as the War Department may consider necessary, to complete the wing-dam, and the residue of the appropriation of one hundred thousand dollars to the extension of the dam on the Moline side; and further, not to obstruct unnecessarily the use of the present water-power during the execution of the work above stated, nor to require the payment of any rent until the improvement contemplated thereby shall have been made, so far as the expenditure of the one hundred thousand dollars will permit.

4th. It is mutually agreed between the Moline Water-Power Company and the United States of America that neither of them shall, at any time, make any obstruction of the water-power, as now existing or hereafter to be developed. It being further understood that this agreement is for the purpose of carrying out the recommendation of the commissioners appointed under the acts of April 19, 1864, and June 27, 1866, relative to the Moline Water-Power Company and water-power at Rock Island, Illinois, and that the recommendation of said commissioners now on file in the War Department at Washington City is regarded as part of this agreement.

In testimony of the foregoing, we, the undersigned, U. S. Grant, Acting Secretary of War, acting for and in behalf of the United States of America, and under authority of the joint resolution of Congress, approved March 2d, eighteen hundred and sixty-seven, and Charles Atkinson, president of the Moline Water-Power Company, acting for and in behalf of the company, have hereunto set our hands and seals, at the place and date set opposite to each respectively.

[SEAL.] U. S. GRANT,
Sec. of War, ad int.

WASHINGTON, D. C., *August 20th*, 1867.

[SEAL.] CHARLES ATKINSON,
President Moline Water-Power Company.

MOLINE, ILL., *June 18*, 1867.

B.

Whereas the Moline Water-Power Company, of Moline, Rock Island County, Illinois, entered into agreement with the United States, under dates June and August, 1867, by which they transferred to the United States their entire interest in the water-power at Moline, Illinois, in consideration that the United States should make and maintain improvements necessary to the development of the same, and grant to said company the use in perpetuity of one-fourth part of the entire power developed, and the further right to rent power upon conditions named in said agreement; and, whereas, in the prosecution of the development of that portion of the water-power contemplated to be used by the United States, it is deemed necessary, for the more complete development and convenient use, that a portion of land, owned by said company, is required for a tail-race to carry off the tail-water of such portion of the water-power as the said company may use; and also that the United States should have the right to abut a dam and a wall against land owned by said company: Now, therefore, for the purpose of facilitating the plans and purposes, and of acting in the spirit of harmony and liberality toward the United States, the said Moline Water-Power Company hereby agrees to the following, viz:

1st. That they will grant and cede to the United States the right of way over and through their land for said tail-race, which is to be of sufficient capacity for the purposes named, free of cost, and will also cede, free of cost, the right to abut a dam and wall against their land at two such points as the United States may select.

2nd. That the United States shall construct and maintain a wagon-bridge for the use of said company over and across said tail-race, at such point as shall be designated by said company, and make suitable dikes to prevent overflow of said company's land. The United States shall be entitled to the building-stone excavated from said tail-race, and half the amount of excavated earth remaining after diking, with the right to remove the same over the company's land.

3rd. The United States shall resume, as early the present season as the stage of water will permit, the development, and prosecute to completion, according to the agreement, the upper portion of the water-power, and the removal of deposits in the pool, and permit the company, if they should desire, to put in a bulk-head at the lower end of the wall built last season, and attach the same to the shore of Rock Island, and remove the same when the development of water-power is completed.

4th. This agreement to cede the land for tail-race, and abutting dam and wall free of cost, is to continue but two years from this date, and the United States Government is to have the right to enter upon the premises for the purpose of going on with the work any time within the two years, by notifying the company that the canal mode of development has been adopted; and upon the completion, by the United States, of the conditions herein named as to the said upper portion, this company binds itself, its successors and assigns, to cede and convey to the United States the premises and privileges hereinbefore named, and also the right to discharge into the company's tail-race the surface-water from the island of Rock Island.

In testimony of the foregoing, we, the undersigned, John A. Rawlins, Secretary of War, acting for and in behalf of the United States of America, and under the authority of the joint resolution of Congress, approved March 2nd, eighteen hundred and sixty-seven, and Charles Atkinson, president of the Moline Water-Power Company, acting for and in behalf of the company, have hereunto set our hands and seals, at the place and date set opposite to each respectively.

JNO. A. RAWLINS,
Secretary of War.

WASHINGTON, D. C., *April 8th, A. D.* 1869.

CHAS. ATKINSON, [SEAL.]
President Moline Water-Power Company.

WASHINGTON, D. C., *April 8th*, 1869.

C.

Whereas, in the prosecution by the United States of an agreement between them and the Moline Water-Power Company, of the State of Illinois, relative to the prosecution of work in the development of water-power at the head of Rock Island, the cofer-dams which the United States had constructed and which were necessary for the prosecution of the work, have been broken and partly carried away by an unexpected and unprecedented rise of water in the Mississippi River, thus stopping all work on the development of water-power and the company's bulkhead, and exposing to danger property of the United States, Moline Water-Power Company, and sundry citizens of the town of Moline, and of the Chicago, Rock Island and Pacific Railroad Company;

and whereas the interests of the United States are adjudged about equal to those of the Moline Water-Power Company and citizens of Moline aforesaid, in the protection of property and the completion of the upper end of the United States dam-wall and the company's bulkhead, both of which works are essential to complete protection of all the above-cited property: It is therefore agreed between Brevet Brigadier-General T. J. Rodman, lieutenant-colonel of Ordnance, commanding Rock Island arsenal, for the United States, party of the first part, and S. W. Wheelock, J. S. Keator, and Dimock and Gould, parties of the second part, that the parties of the second part, representing the interests of the Moline Water-Power Company, and of the citizens aforesaid, shall replace the coffer-dams, bare the bottom of the pool, and keep it so during the prosecution to completion of the wall and the company's bulkhead, and that the upper coffer-dam shall be kept at all times at a height to prevent the flow of water and ice over it, and both coffer-dams to be constructed in a manner satisfactory to the commanding officer of Rock Island arsenal and parties above named. And it is agreed that the United States shall furnish material or pay for material furnished by the parties of the second part to an extent equal in amount to one-half the cost of the entire work above recited to be done, on properly attested vouchers, after they shall have been examined and approved by the commanding officer of Rock Island arsenal, or other officer or person appointed by him. The party of the first part also agrees to allow the parties of the second part the use of boats, engine, and pump, and such tools which have been in use in the prosecution of the development of water-power as can be spared, with the understanding that they shall be returned in good order. It is also understood and agreed that all materials and labor used in the prosecution of this work by the parties of the second part shall be procured at the lowest market rates, payment to be made by the party of the first part monthly as the work progresses. It is also understood and agreed that if from any unforeseen cause the parties of the second part should be unable to perform the work as above stipulated, the expense incurred in pursuance of this agreement shall be borne equally by the parties to this agreement.

It is also agreed that, as soon as the pool shall have been bared by the parties of the second part, the party of the first part shall commence work on the dam-wall and push it forward to completion as rapidly as practicable, and that the parties of the second part shall be responsible that the Moline Water-Power Company's bulk-head shall be completed by the time the aforesaid wall shall have been completed.

It is also agreed that whatever amount may be received from the Chicago, Rock Island and Pacific Railroad Company, for its share of the expense incurred in giving its property security, shall be divided equally between the parties of the first and second part hereto. Signed at Rock Island arsenal this 28th day of October, 1869.

T. J. RODMAN,
Lieutenant-Colonel Ordnance and Brevet Brigadier General, U. S. A.
S. W. WHEELOCK.
DIMOCK AND GOULD.
J. S. KEATOR.

D.

Whereas the Moline Water-Power Company is desirous of utilizing, as far as compatible with the public interest, their portion of the water-power already developed by the United States in accordance with agreements between said company and said United States, pending the complete development of said water-power; and whereas it will probably require an increased expenditure of money on the part of the United States to make provision for the utilization of power by said company, pending said complete development:

Therefore, the Moline Water-Power Company hereby agrees and binds itself to pay to the United States, as soon as the amount or amounts thereof shall be ascertained and given by the officer in charge of the work, all expenses of whatever kind which they may incur in making provision for the utilization of water-power, as above described, provided that the Secretary of War shall require such payment to be made; and provided further, that the said Secretary of War shall be the judge as to the times when, and the extent to which, the public interest will admit of the utilization of power, as above specified.

The Moline Water-Power Company further agrees to not require the removal by the United States of materials belonging to them and being upon the company's land, and that were procured for the development of water-power, so long as their use shall be delayed by reason of making provision for and permitting the use by said company of water-power already developed, pending the complete development of water-power by the United States.

It being distinctly understood that nothing herein contained shall be so construed as to in any wise affect the rights of either party as expressed in the existing agreements between the United States and the Moline Water-Power Company.

It is further agreed and understood that the opening which is to be left between the end of the wall and the dike for the escape of the company's water, pending the complete development of the water-power, shall not be closed until after the canal shall have been so far completed that the material to be removed therefrom shall be adjudged by the officer in charge of the work to be sufficient therefor; so that the closing of the gap and the completion of the canal may take place as nearly as practicable at the same period of time.

Moline, September 6th, 1870.

CHARLES ATKINSON,
President Moline Water-Power Comp'y.
J. M. GOULD, *Secretary.*

Respectfully submitted to the Secretary of War, recommended.

A. B. DYER,
Chief of Ordnance, U. S. A.

ROCK ISLAND ARSENAL, *September 7th*, 1870.

Approved.

It is decided that all expenses of whatever kind which may be incurred by the United States for the benefit of the Moline Water-Power Company, and to enable it to use the water pending the complete development of the water-power, shall be borne by the Moline Water-Power Company.

WM. W. BELKNAP,
Secretary of War.

ROCK ISLAND ARSENAL, *September 7th*, 1870.

CHAPTER VII.

HISTORY OF THE ARSENAL UNDER GENERAL RODMAN'S COMMAND FROM THE TIME OF THE MEETING OF THE BOARD OF COMMISSIONERS, IN OCTOBER, 1866, UNTIL THE TIME OF GENERAL RODMAN'S DEATH, IN JUNE, 1871.

Prosecution of work of constructing the arsenal and armory—Description of island—Statement of money appropriated, received, and expended during General Rodman's command—The Rock Island wagon-bridge—Purchase by United States of old wooden bridge—Approach to bridge—Donations of land for approach to bridge—Estimate for new bridge—Act of Congress approved July 25, 1868—Description of bridge, abutments, and piers—Superstructure—Completion of bridge—Damage by high water—Causeway on the island—Water-reservoir—Plan and explanation—Authority for its construction—Description of structure—The boiler-attachment—Capacity of the reservoir—Repairs to reservoir—Construction of Shops B and C—Materials used and cost of same—Contractors—Plans for commanding officer's quarters—Materials to be used—Estimated cost—Approval of plan and authority to construct commanding officer's quarters—Excavation for foundation begun—Difficulties in procuring building materials—Complaints and claims of contractors—Refusal of contractors to deliver stone—Purchase of stone—Work on buildings done by the day—Absence of General Rodman—Officers in temporary command of the arsenal—Officers stationed at the arsenal from 1865 to 1871—Death of General Rodman—Place of burial—Sketch of General Rodman's life.

HISTORY OF THE ARSENAL UNDER GENERAL RODMAN'S COMMAND FROM THE TIME OF THE MEETING OF THE BOARD OF COMMISSIONERS, IN OCTOBER, 1866, UNTIL THE TIME OF GENERAL RODMAN'S DEATH, IN JUNE, 1871.

This chapter gives an account of the prosecution of the work of constructing the arsenal and armory only so far as it relates to improvements on the island, the construction of buildings, and the Rock Island wagon-bridge. An account of the prosecution of the work in carrying out the plans adopted for the Rock Island bridge and water-power has already been given in Chapters V and VI. In Chapter III was given a description of the island and of the plans adopted for the armory and arsenal, and reference to the description there given will be necessary to an understanding of what follows.

During the time under consideration, that is, from 1866 to June, 1871, the work done at the arsenal was as follows:

The reservoir and Rock Island bridge were built. (See map on Plate

VI.) Shops B and C and commanding officer's quarters were begun and nearly completed, and a good deal of work was done in clearing up undergrowth, improving the grounds, and laying out roads. The permanent roads built were West avenue from its north end nearly to Main avenue, and Main avenue from East avenue to the Moline bridge.

As annual reports of the principal operations of the arsenal were not made during the period of time under consideration, the history of the work is compiled from correspondence, special reports, estimates, and records of expenditures.

The appropriations and expenditures for the arsenal during the period of time embraced in this chapter were as follows:

Funds appropriated for, received and expended at, Rock Island arsenal, Illinois, from 1867 to 1871.

[This statement includes nothing in regard to appropriations other than those for Rock Island arsenal.]

Fiscal year ending June 30—	Acts of Congress approved—	Amounts appropriated.	Amounts received.				
			From the United States Treasury.	From sales.	By transfers.	From rents.	Total.
1867	June 22, 1866	$200,000 00	$260,000 00			$3,069 13	$263,069 13
1867	June 22, 1866	*293,600 00					
1868	March 2, 1867	886,500 00	901,349 50		$7,643 20	1,699 06	910,691 76
1869	June 8, 1868	480,000 00	604,000 00	$271 44		383 50	604,654 94
1870	March 3, 1869	1,000,000 00	679,500 00	783 00		12 00	680,295 00
1871	July 15, 1870	360,000 00	385,672 90		1,004 90	16 05	386,693 85
	Total	3,220,100 00	2,830,522 40	1,054 44	8,648 10	5,179 74	2,845,404 68

* This amount was appropriated by Congress to liquidate claims against the United States for property at Rock Island, adjudicated by the board of commissioners. The money was not drawn from the Treasury by the commanding officer of the arsenal, but $242,082.52 of it was paid out by the Treasurer of the United States in the settlement of the claims.

Of the other appropriations $95,977.60 was not drawn from the United States Treasury by the commanding officer of the arsenal.

Fiscal year ending June 30—		Expenditure.					
		For construction of buildings and other arsenal work.	For Rock Island water-power.	For Rock Island bridge.	Transferred to other appropriations.	Refunded in the United States Treasury.	Total.
1867	Disbursements	$234,565 10			$33,785 05		$268,350 15
1868	do	288,761 17	$9,429 34		8,193 70		306,384 21
1869	do	404,551 99	179,994 60	$1,794 47		$400,000 00	986,341 06
1870	do	595,068 99	141,982 96	4,869 86		783 00	742,704 81
To May 31,1871.	do	336,394 31	106,099 45				442,493 76
		1,859,341 56	437,506 35	6,664 33	41,978 75	400,783 00	2,746,273 93
	Amount on hand May 31, 1871						99,130 69
	Outstanding indebtedness May 31, 1871	29,899 11	3,000 00				32,899 11
		1,889,240 67	440,506 35	6,664 33			2,336,411 35
	Outstanding indebtedness incurred prior to July 1, 1866, and paid after that date, to be deducted	33,785 05					33,785 05
	Total cost of work done from July 1, 1866, to May 31, 1871	1,855,455 62	440,506 35	6,664 33			2,302,626 30

ROCK ISLAND WAGON-BRIDGE.

This is a bridge for wagons and foot-passengers only, and connects the arsenal with the city of Rock Island. (See map on Plate VI.) Its piers and abutments were put in in the fall of 1868, and the superstructure was erected in the following summer. By reference to the report of the board of commissioners and action taken thereon, in Chapter IV, it will be seen that the United States purchased from the city of Rock Island a wooden bridge and causeway connecting the city of Rock Island with the island, and some property called Wilson's Island, which the causeway crossed. By this purchase the United States acquired a title to the land occupied by the bridge and its south or city approach. The ground occupied by this approach, and owned by the United States in the city of Rock Island, is inclosed and shown by a dotted line on the map on Plate VI. The United States did not, however, acquire all of this ground by the above purchase. After the purchase was completed, the city of Rock Island widened so much of Arsenal street as lies north of the track of the Chicago, Rock Island and Pacific Railroad, and 39 feet on its east side, and donated to the United States the land thus added to the street. This piece of ground was triangular in shape, because the line of Arsenal street makes an angle with the line of the bridge. This did not cover all the ground required for the approach on its east side, and subsequently Mr. Bailey Davenport, of Rock Island, who owned the adjoining land, gave to the United States a quit-claim deed to the small triangle, bounded by the land donated by the city of Rock Island on one side, and by the present east line of the approach and the river-shore on the other two sides. These two triangles are not shown on the map. A plat of the ground and the deeds covering it are on file at the Rock Island arsenal. On the west side of the approach the boundary-line of land owned by the United States is beyond the boundary-line of the approach.

In March, 1868, the old wooden bridge purchased from the city of Rock Island was destroyed and carried away by the ice. From that time till the new bridge was completed, communication with the city was kept up by a ferry or by a temporary structure on the site of the bridge. Immediately after the destruction of the old bridge, General Rodman sent to the Chief of Ordnance an estimate for a new bridge, and requested that early action might be taken to procure from Congress an appropriation for its construction. The following is the act of Congress passed soon afterward making the necessary appropriation:

AN ACT making appropriations for sundry civil expenses of the Government for the year ending June thirty, eighteen hundred and sixty-nine, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated for the objects hereinafter expressed, for the fiscal year ending the thirtieth June, eighteen hundred and sixty-nine, viz:

ROCK ISLAND ARSENAL.

For the erection of a bridge to connect Rock Island arsenal with the city of Rock Island, Illinois, one hundred thousand dollars; said bridge to be constructed and completed for the sum hereby appropriated.

Approved July 25, 1868.

On the 8th of September, the Chief of Ordnance informed General Rodman that the appropriation was available for use, and work on the piers and abutments was begun soon afterward. The bridge as finally built is as follows: It is a through bridge, 600 feet long, of four equal spans. The

wagon-road is 22 feet wide in the clear, and the footwalks outside the chords, one on each side, are 6 feet wide. The truss is the Whipple, with diagonal main posts. All the posts and the top chord are the patent Phœnix wrought-iron column, and the top-chord connections, angle-brackets, and post-caps, and feet are of cast iron. The floor-beams are 12-inch wrought-iron I-beams, and the stay-rods round bar-iron. The floor of the wagon-way was made of 2½-inch oak plank, and the footwalks of 1½-inch oak. The former has been worn out twice, and has been renewed each time with 3-inch oak, and the latter has been worn out once and renewed with 2-inch pine. The bridge is built to carry a load of 2,500 pounds per lineal foot, with a strain of 10,000 pounds per square-inch upon the iron parts under tensile strain, and of 6,000 pounds per square-inch upon the iron parts under compressing strain. The piers are of heavy stone masonry laid in courses. Their dimensions at the bottom are: Total length, including cutwaters, 60 feet, and width 10 feet. There is a cutwater at each end. The batter of the cutwater is 20 on 9, and of the side-walls 20 on 3, except the top 4 feet 8 inches, which is vertical. At the top the piers are 5 feet wide, and are covered by a coping which projects 6 inches. The average height of piers and abutments is 24 feet. The foundation of the south abutment only is rock. The foundation of the other abutment and of the piers is a hard, well-cemented gravel, a few feet below the bed of the river. On this is laid a longitudinal grillage of 6-inch by 8-inch timbers, crossed above by a second grillage of timbers of the same dimensions. On these are laid, first, a footing-course 14 inches thick covering the whole grillage, and then another footing course, 2 feet thick, conforming to the shape of the pier or abutment. For putting in the piers their site was bared by coffering and pumping out in the ordinary way. The stone for the masonry was furnished by Messrs. Sanger & Steel from their quarries near Joliet, Ill. They were built by the United States, and all the work was in charge of Maj. Theodore Edson, Ordnance Department, United States Army. They were completed and ready for the superstructure in December, 1868. The iron for the superstructure was furnished by the Phœnix Iron Company of Phœnixville, Pa., and the superstructure was manufactured and put up ready for use, including floors, footwalks, and painting, by Charles Kellogg, of Phœnixville, Pa., under a contract made December 12, 1868. The iron parts under a tensile strain were required to possess an ultimate tenacity of 60,000 pounds per square inch. They were found by test to have a tensile strength of only 53,000 pounds per square-inch, and in consequence of this a deduction of one-half cent per pound was made on the contract-price for the superstructure. The tests of the iron were made and the construction of the superstructure superintended by Lieut. W. P. Butler, Ordnance Department, United States Army. The bridge was completed, ready for use, and was accepted in September, 1869. On the 30th of September, 1869, the coffer-dams across the upper end of the south channel, where work on the upper dam-wall of the water-power was in progress, were broken and washed out by a remarkable and unprecedented rise in the river, and the current of the river passed down this channel with great force.* It caused some scouring of the gravel under the piers and the north abutment. The west end of the north pier sank about 1¾ inches, and after the water subsided a crack was found in this and the middle pier just above low water. All the piers and the north abutment have since been thoroughly protected by a heavy riprap of loose rock, and are believed to be perfectly secure.

* A more complete account of this accident is given in the history of the construction of the upper dam-wall of the water-power in the sixth chapter of this book.

To make a roadway from the island to the bridge, the causeway to the old wooden bridge was widened and raised by dredging sand and mud from the river and from the site of Wilson's Island. The sloping sides of the causeway were then protected by riprap walls. This causeway is 600 feet long and 42 feet wide on top.

WATER-RESERVOIR.

The reservoir was begun in June, 1869, and finished in December of the same year. Its ground plan, as shown on Plate VI, complete drawings, (No. 44,) and a description of it, were sent to the Ordnance Office with the annual report of principal operations at the arsenal for the year ending June 30, 1875.

The following correspondence gives the authority for the construction of the reservoir, and General Rodman's views respecting the same:

ROCK ISLAND ARSENAL, *July 3d*, 1868.

Brevet Major-General A. B. DYER,
Chief of Ordnance, Washington, D. C.:

SIR: Yours of the 25th ulto., advising me that an appropriation of $300,000 for Rock Island arsenal and $80,000 for water-power had been made, and would be available after the 1st inst., and calling for my recommendation as to the objects to which the $300,000 should be applied, is received.

In reply I would recommend that it be applied to the following objects, viz:

Construction of stone reservoir, magazine for powder and fixed ammunition, and clearing up grounds, making roads, &c.

The reservoir, say $18,000; for magazine, say $50,000; for roads, &c., say $5,000, and the remainder to completion of shops at points B and C.

Inclosed herewith I send drawings of proposed stone reservoir, and plans showing proposed site thereof.

Reflection upon the subject has led me to the conclusion that it will be more economical and better to build *one* large reservoir with a partition in it, thus making it equivalent to two, than to build *two* or more separate reservoirs at different points.

The twenty-five feet above ground will give head enough to carry water into second story of shops and other buildings now contemplated to be built here, and the four feet below may be used for sluicing out sewers, or be drawn out by fire-engine in case of fire. The partition will enable us to clean out or repair one half while using the other. The site selected and shown on plan is central, and I think the most eligible that can be had. The cost of this reservoir will be considerably more than that named in my annual estimate for a reservoir, but that was intended to only partially meet our wants in that line, while this one is intended to meet our entire wants in that line, and the, $18,000 named in my last estimate, together with the $10,000 heretofore appropriated will, I think, about build this reservoir and furnish and lay the pipes required for it immediate use. The immediate commencement of this reservoir is rendered necessary by the very rotten condition of the wood in the old tank which we are now using as a reservoir. The cleaning and supply pipes shown will enable us to sluice out both the sewers under the shops, on which men's privies will be located, and that draining swamp and commanding officer's permanent quarters. Ten-inch pipes will be required to give full sluicing effect to the water.

The magazine is greatly needed, but owing to the amount of other more pressing work on hand and in progress, I do not see that anything more than to prepare the foundation could be done on it this season.

Very respectfully, your obedient servant,

T. J. RODMAN,
Lieutenant-Colonel of Ordnance, Brevet Brigadier-General, U. S. A., Commanding.

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, April 14, 1869.

Brevet-Brigadier T. J. RODMAN,
Commanding Rock Island Arsenal:

SIR: Your letter of this date, proposing to anticipate the appropriation for building wagon-bridge to connect Rock Island and Moline City by using money available for other purposes at Rock Island arsenal, and submitting plan for a stone reservoir at Rock Island arsenal, having been submitted to the Secretary of War, and received his approval, you are now authorized to build the bridge and reservoir as soon as practicable.

T. J. TREADWELL,
Brevet Lieutenant-Colonel and Major of Ordnance, in charge.

The stone for the foundation was quarried on the island, and that for the walls was taken from stone furnished for Shops B and C. The only stone purchased was the coping and the flagging for the floor. The work of construction was under the immediate charge of Capt. F. H. Parker, Ordnance Department, U. S. A. The total cost of the reservoir was $30,427, and in this was included the necessary pipes, water-gates, a boiler-house, boiler, and connecting-pipes. As completed, the reservoir was as follows: It was circular in form; interior diameter, 80 feet; height of wall from floor of reservoir, 32 feet 8 inches; thickness of wall at floor-line, 8 feet; at top, 2 feet 10 inches. It was covered with a coping 10 inches thick, projecting 5 inches. The wall was further strengthened with buttresses placed 15 feet apart, 2 feet wide, projecting 3 feet from the face of the wall at the bottom, and battering to the face-line of the wall at the top. The exterior of the wall is heavy ashlér limestone, laid in courses of from 10 inches to 20 inches thick, backed on the interior by rubble, also laid in courses. The interior division-wall is 11 feet 5 inches high. Outside the reservoir, on the south side, is a stone boiler-house, provided with a water-boiler and circulating water-pipes communicating with the interior of the reservoir. The object of this arrangement was, by heating the water, to prevent the formation of ice in the reservoir and injury therefrom to the walls. All the masonry was laid in Utica cement mortar. The reservoir is provided with receiving and discharge pipes to each interior compartment, and the latter have each two branches, one to the service-mains and one to a waste-pipe. The diameter of all these pipes is 8 inches. The total capacity of the reservoir was 1,200,000 gallons, but it was thought that the walls were not sufficiently strong to bear the pressure, and the overflow-pipe was placed 7 feet below the top of the wall, which reduced the capacity to about 928,000 gallons. Some extensive repairs of the reservoir, consisting mainly of a roof and water-tight lining and floor, were made in the year ending June 30, 1875, a full account of which is given in the annual report of principal operations for that year. These repairs and alterations have changed slightly the forms and dimensions given above.

The following experience with the boiler-attachment for warming the water in the reservoir may be interesting and is useful. As stated, the object of the arrangement was to prevent the formation of ice on the water in the reservoir to such an extent as would injure the walls. The boiler was connected with the water in the reservoir by two 4 inch pipes. The opening of one of these was at the reservoir-floor, and the other 12 feet above the floor. The boiler was fired effectually during the cold of winter, but I could never observe that it produced any effect on the ice in the reservoir. The ice gradually increased in thickness till toward spring, much as it did on water outside. At first it was supposed that the boiler or its pipe connections were defective; on examination, I found the "feed" pipe two feet above the boiler at a temperature of about 32°, and the boiler itself, with a good fire under it, not much warmer. After reflection, and making some calculations, it was clear that the water must be passing through the upper pipe down into the boiler, instead of up from below, as was intended, on account of the amount of water drawn off in the service-mains; the temperature of the water in the reservoir being at 32°, the capacity of the boiler being small, and the feed-pipe having a diameter of 4 inches, it was impossible that the water should be heated to a temperature above that corresponding to its maximum density, about 40°, and the effect of the heating was then to draw down the cold water from above, warm it to a temperature below 40°, and pass it on to the floor of the reservoir, whence it was drawn off in the service-

mains. It could have no effect on the surface-ice in the reservoir, but it was more useful in another way. It warmed the water in the service-mains to a temperature above freezing. To this circumstance I ascribe the saving of the arsenal mains from destruction by frost in the extremely cold winter of 1873 and '74, when the grading over them was not completed and they were not well protected, and when a large portion of the mains in cities in this vicinity were destroyed.

CONSTRUCTION OF SHOPS B AND C AND COMMANDING OFFICER'S QUARTERS.

Shops B and C.

In all letters and papers originating in the period of time under consideration these shops are called Nos. 1 and 2, respectively; that is, Shop B is called No. 1, and Shop C No. 2. Their names were changed in the summer of 1871. The reason for the change was that two more shops, D and E, were begun. It was natural to number them 3 and 4, and as this left out Shop A, (see map on Plate I,) the system of numbers was confusing. It was necessary for convenience to adopt some system in which the name would designate the location of each shop without other description, and as the numbers 1 and 2 were already fixed they could not be readily changed, therefore the system of letters was fixed upon. Shop B was begun in October, 1866, and was finished in December, 1871. Shop C was begun in September, 1867, and was finished in June, 1873. Work on the two shops was carried on simultaneously, and the expenditure on them was not kept for each separately. The appropriations for the arsenal during the time these shops were being built were made under one head, for the construction of buildings, and separate accounts of expenditure for different parts of the work were not kept. Materials for the shops, the commanding officer's quarters, and the reservoir were purchased together, and used as required. Contracts for work to be done also included all the buildings, and finished work on all was measured up together. The stone was furnished by Messrs. Sanger & Steel, of Joliet, Ill., from their limestone-quarries on the Illinois and Michigan Canal, about two miles north of Joliet. The price paid was $6 per cubic yard, delivered at the quarries and measured in the walls of the buildings, excluding all openings and builder's or constructive measurements. The cost of transportation to the arsenal was about $5.50 per yard. A description of the walls and their construction, and of the dimensions and character of stone used, is given in Chapter II.

The iron for the two shops was furnished under contract by the following-named parties:

Messrs. Cooper & Hewitt, of New York, furnished the 15-inch I-beams (stringers) for the first and second floors, and all the 12-inch I-beams (joists) for the second floors. Date of contract, April 21, 1868.

The Union Iron Mills, of Pittsburgh, Pa., furnished all 12-inch I-beams (joists) required for the first floors. Date of contract, May 8, 1868.

The Phœnix Iron Company, of Philadelphia, furnished all the 12-inch I-beams (stringers) and all the 9-inch I-beams (joists) required for the third floors, all the wrought-iron columns and cast-iron column caps and bases required for both shops, and the wrought-iron roof-frames for both shops, manufactured ready to be put up. Date of contract, May 20,

1868. The prices paid for the iron delivered at the arsenal were as follows:

	Per 100 pounds.
For 15-inch I-beams	$6.84
For 12-inch I-beams	6.61¼
For 9-inch I-beams	6.36¼
For wrought-iron columns and cast-iron caps and bases	6.70
For wrought-iron roof-frame	7.15

The cement for both shops was furnished by Messrs. James Clark & Sons, of Utica, Ill., at $1.55 per barrel of 300 pounds delivered at the arsenal. The lime was purchased from W. B. Barnes, of Rock Island, Ill., at 90 cents per barrel of 200 pounds delivered at the arsenal. The oak flooring was furnished by Messrs. French & Davies, of Davenport, Iowa, at $41.50 per M, and the pine lumber by Mr. J. S. Keator, of Moline, Ill., at prices varying from $17 to $22 per M.

The copper-work was furnished and put on by Mr. F. Hass, of Rock Island, Ill., and cost about $13,000 for each shop.

The glass used was manufactured by Knox, Kline & Co., of Pittsburgh, Pa., and was furnished by Messrs. H. Dart's Sons, of Rock Island, Ill. The fire-proof brick arches were put in by Messrs. Atkinson & Murdock, of Rock Island, Ill., at $15.50 per M, (builder's measurement.)

On the 9th of December, 1869, an agreement was made with Mr. Lyman Bridges, of Chicago, Ill., for the slating of the two shops at $21 per square, Mr. Bridges to furnish all the material and do all the work. Mr. Bridges failed to comply with the terms of the agreement, either as to quality of material or time in which the work was to be done, and finally the contract was annulled in October, 1870, and a new agreement was made with Messrs. Aiken & Co., of Pittsburgh, Pa., to do the work at $15.25 per square. This was the price for Shop B and for the commanding officer's quarters, but for Shop C the price was reduced to $14.50 per square. The work was done promptly and satisfactorily, under the charge of Mr. Charles C. Hipwell, a foreman of Aiken & Co. Mr. Hipwell afterward established himself in business in Davenport, Iowa, and has slated nearly all the buildings erected at the arsenal.

Commanding officer's quarters.

This building was commenced in May, 1870, and was completed in October, 1871. The work throughout was in the immediate charge of Lieut. W. P. Butler, Ordnance Department, one of the officers stationed at the arsenal. Plans for the building were submitted to the Chief of Ordnance by General Rodman in February, 1869, and were approved by the Secretary of War. Following is the correspondence on the subject:

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, February 3d, 1869.

Brevet Lieutenant-Col. T. J. TREADWELL,
In Charge of Bureau:

SIR: I have the honor to inclose herewith drawings of permanent quarters for commanding officer at Rock Island arsenal, Illinois. It is proposed to build these quarters of Joliet stone on the exterior, the interior walls and the lining of the exterior walls to be of brick. I have not had time to go into a detailed estimate of the cost of these quarters, but am of the opinion that they will cost about ($50,000) fifty thousand dollars. It is proposed to commence these quarters the coming spring, as by the time they can be completed and ready for occupancy the flooring of the temporary quarters will be so far decayed as [to] require renewal to render them habitable.

I therefore request that the drawings herewith submitted may be acted upon as soon as may be found convenient.

I am, very respectfully, sir, your obedient servant,

T. J. RODMAN,
Brevet Brigadier-General, U. S. A., Commanding Rock Island Arsenal.

To which the following reply was received:

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, March 24, 1869.

Brevet Brigadier-General T. J. RODMAN,
Commanding Rock Island Arsenal:

SIR: The Secretary of War having approved the plan for commanding officer's quarters at Rock Island arsenal, and authorized their construction as proposed in your letter of 3d ultimo, you will now take the necessary measures for the erection of these quarters as soon as practicable.

Respectfully, your ob't servant,

T. J. TREADWELL,
Brevet Lieutenant-Col., Major of Ord., in charge.

The building as completed is substantially in accordance with the plans. Excavation for the building was commenced on the 1st of May, and the work on the walls progressed as rapidly as possible till they were completed. Owing to vexatious delays in procuring sufficient supplies of stone from the contractors, (described a few pages further on,) the walls were not completed during the season for outdoor work, and a great part of the stone-work was done during the intense cold weather of winter. Fires and a large use of hot water and salt were required in preparing the mortar, and the walls were not completed until about the middle of January, 1871. This added considerably to the cost of the work.

The building was roofed in as soon as the walls were finished, and the work on the interior progressed without interruption until the building was completed.

Much difficulty was experienced in procuring sufficient supplies of stone for Shops B and C and for the commanding officer's quarters. The deliveries of stone were not equal to the demand, and the terms of the contractors' agreement were not carried out in this respect. This caused vexatious delays in the work, and at times stone cutters and masons were suspended from work while waiting for stone. The correspondence on the subject shows that the contractors accepted other orders for stone more favorable to them, and delivered stone suitable for the arsenal buildings to other parties while the contract with the Government was in force and the stone needed at the arsenal. The contractors claimed that the character of the masonry and the stone required were not what they had been led to suppose when the agreement was made; that a more valuable stone was required than the agreement called for, and that the contract-price was too low. If this was true, it appears to have been the contractors' fault, for the history of the case shows that great care was taken to show them and they were probably fully informed of the character of the masonry required. It was also sufficiently described in the specifications of the agreement. There were also many other complaints from the contractors, which were certainly unreasonable, except the two following, which were important and well-founded:

It was claimed, and it is true, that considerable quantities of valuable ashler suitable for face-stones were used in backing up the walls of the basement of Shop B, when rubble should have been used, and this stone was worth four or five times as much at the quarries as the rubble. It appears, however, that this was done with the knowledge and consent of the contractors, and that it was stopped as soon as complaint was made. It was also claimed, and it appears to have been true, that good economy was not used in the consumption of the stone; that is, in drilling up, cutting, and preparing the stone for the walls there was an un-

necessarily large waste, and that some of the stone so wasted was suitable for building purposes, and should have been so used.

This last claim was admitted in the final settlement. The amount of some of this waste stone was determined, and the contractors were paid for it at the rate of fifty cents per cubic yard, and the stone was used in paving gutters, roadways, foundations, and other similar work.

Messrs. Sanger & Steel did not deliver all the stone required for buildings included in their agreement. They continued to deliver stone until August, 1870, and then refused to deliver any more unless they were paid forty cents per foot for the remainder of the dimension-stone required. There was then required an amount of four hundred and forty-one yards of dimension-stone to complete Shop C and the commanding officer's quarters, and it was the most valuable and costly stone used in the buildings. It was finally purchased from Mr. Edwin Walker, of Lamont, Ill., at an average price of 38½ cents per cubic foot. This stone is the same in appearance and is almost identical in character and quality with the Joliet stone.

There is not much else in connection with the history of the construction of these buildings that is interesting or of importance. All of the work, except that described in the preceding pages, was done by day-workmen, employed and paid by the Government. The work was directed and superintended directly by officers of the Ordnance Department stationed at the arsenal, and the necessary engineering-work, calculations, making of tests, experiments, &c., was also done by the officers.

During his command of the arsenal, General Rodman was necessarily absent a considerable part of the time in conference with the Chief of Ordnance in Washington and attending to his duties as constructor of ordnance. During his absences the immediate charge of the work devolved upon the second officer in rank stationed at the arsenal. In this way, Lieut. John A. Kress, Ordnance Department, was in charge of the arsenal from August 26, 1865, to October 24, 1865; from February 10, 1866, to April 4, 1866, and from November 8, 1866, to March 28, 1867. Maj. Theodore Edson, Ordnance Department, was in temporary command from October to December, 1867; from January 2, 1868, to April 24, 1868; from August 29, 1868, to September 22, 1868, and from February 15, 1869, to April 20, 1869. Major Edson was an officer of high ability, and much important work at the arsenal, including the construction of the Rock Island wagon-bridge, was under his charge.

Capt. (now Major) A. Mordecai was in temporary command from January 21 to May 3, 1870.

During the winter and spring prior to his death, General Rodman was too ill much of the time to leave his room, and the immediate charge of all work at the arsenal devolved upon Capt. Morris Schaff, Ordnance Department, and from March to June, 1871, upon Capt. Clifton Comly, Ordnance Department, the second officers in rank stationed at the arsenal.

During General Rodman's command the following-named officers of the Ordnance Department were stationed at the arsenal as assistants: Lieut. John A. Kress, from July, 1865, to July, 1867; Lieut. W. P. Butler, from October, 1866, to July, 1873; Maj. John W. Todd, from January 3, 1867, to April 11, 1867; Maj. Theodore Edson, from June 15, 1867, to July 12, 1869; Capt. Clifton Comly, from June, 1867, to May, 1871; Lieut. Charles Shaler, jr., from September, 1867, to August, 1868, and from July, 1870, to August, 1874; Capt. F. H. Parker, from November, 1868, to October, 1869; Capt. Morris Schaff, from Novem-

ber 10, 1868, to December 31, 1871; Lieut. M. L. Poland, from December 23, 1868, to August 5, 1871; Lieut. Henry Metcalfe, from May 24, 1869, to August 12, 1869; Capt. A. Mordecai, from August 20, 1869, to August 11, 1870.

General Rodman died at his quarters at the arsenal on the 7th of June, 1871. By his death not only the Army and the Ordnance Department lost one of the most valuable officers in the service, but the work of constructing the arsenal received a serious blow. The plans for the work were his, and all that he planned to do was not and could not be communicated to others. His extraordinary ability, wide influence, and the complete confidence reposed in him by the Department, the Government, and all whose assistance was needed for the work, gave him a certainty of success in carrying out the plans for the great work that no one else could have. At the request of the Chief of Ordnance he was buried at the arsenal, on a lot of ground set apart for that purpose, near the national cemetery at the east end of the island. He was so closely identified with the work of building the arsenal, and his labors form so important a part of its history, that a short sketch of his life is not out of place here.

The following is copied from an article published in the Army and Navy Journal a short time after his death:

Sketch of General Rodman's life and services.

During the last decade and longer, so conspicuous has been the part borne by General Rodman in all that relates to the improvement of our *matériel*, so great have been the meliorations suggested and perfected by himself, so sound and discriminating has been his judgment in sifting proposed improvements, approving of the good and rejecting the worthless, that it will be long before the place which is now made vacant by his decease can be filled; long before the Department of which he was so distinguished an ornament can cease to feel and lament his premature death.

It is due to the memory of General Rodman's unusual services, and especially is it due to ourselves as evincing our appreciation of his greatness and the magnitude of his achievements, that we should gather together from the records of his life a brief notice of his principal labors and their results, that those who come after him may mark the progress of improvement in that branch of science to which he devoted his life, may know to whom they are indebted for some of the most striking and important improvements made in it, and that the patient and laborious investigator may take courage from his example, and the success which crowned his labors, to persevere and press onward.

It had been hoped that some one more competent to do full justice to the subject would come forward to assume this duty, and it is only in the absence of any extended notice of his labors that the hand of friendship, in the present case unaccustomed to the performance of such a task, ventures to gather a few leaves of laurel and weave a wreath to place upon his brow.

Thomas J. Rodman was born at Salem, Ind., July 30, 1815. His youth was passed on his father's farm, engaged in tilling the soil, working with his own hands. He entered West Point July 1, 1837, well developed, with a strong constitution, capable of enduring any amount of labor, and thoroughly alive to the advantage there afforded him for intellectual improvement. His career as a cadet was marked by a close attention to his daily duties, and a thorough preparation for every lesson. He was graduated July 1, 1841, seventh in general merit in a class of fifty-two; was appointed a brevet second lieutenant in the Ordnance Department, and assigned to duty at the Allegheny arsenal, Pittsburgh, Pa.

From the time of his first joining his station he showed a determination to become master of his profession, by a close attention to all the practical details as carried on in the shops, and he early gave evidence of personal ingenuity and a decided mechanical turn of mind, qualities of so high importance to a thorough and successful ordnance officer.

In 1845 he was assigned to foundery duty, to superintend the casting of heavy iron cannon. The appearance of the sinking head at once attracted his attention. The porous state of the metal, torn at the center by the contraction in cooling, convinced him that there was something wrong in the principle on which guns were made; and he was confirmed in this opinion when he came to investigate the laws of the strain to which they are subjected when fired. He first proposed to correct these errors by mak-

ing a gun of a solid wrought-iron core in which to form the bore of the gun, and to wrap around it in successive layers a wire of peculiar shape and with a constant tension. There were practical difficulties in executing this design, and it then occurred to him that if he could cool a cast-iron gun from the interior, keeping the exterior in a fluid state, he would have exactly the same condition of things, so far as the different parts of the gun were concerned, as in the plan first proposed. The successive layers of metal would be shrunk one upon another, each layer being compressed by the shrinking of its next outer layer.

If a gun thus made were broken by a charge of gunpowder, every part of the gun from the surface of the bore to the exterior would be brought to the breaking point at the same time, and not one after another in succession, as he was convinced was the case in guns cast solid and cooled from the exterior. This plan of casting guns and the *rationale* of the process were explained by him to the higher officers of his corps, and he urged earnestly that an experimental gun might be made and tested by the Department in proof of the truth of his theory. The brevet second lieutenant received no encouragement, the invention was not indorsed by a single officer of rank, its merits were not appreciated, and the idea of introducing a stream of water, though protected by a cast-iron pipe, into the center of a mass of molten metal, seemed too hazardous to be countenanced. Three times the offer of the invention was made to the acting head of the Department, and it was thrice rejected. Lieutenant Rodman, seeing that there was no prospect of having his invention tested by the Government, then asked his chief if there was any objection to his getting it undertaken by private enterprise, and securing it by letters-patent. "Certainly not," was the reply of the chief, apparently pleased to be rid of the subject in this manner.

Messrs. Knap & Totten believed the invention to be useful and practicable, though a little doubtful at first as to the safety of using water for cooling the gun. On this account the first gun that was cast on this plan was cooled by a blast of cold air from a rotary fan, forced to the bottom of the core-barrel, and continued until the gun was cold. The first experiment proved that no danger was to be apprehended from the use of water, and as air did not carry off the heat as rapidly as was desired, it was determined to substitute water. Accordingly, afterward a stream was conducted by an iron pipe to the bottom of the core-barrel, whence it rose and flowed over the top and was carried off.

Eight different pairs of guns, one cast hollow and cooled from the interior, and the other cast solid in the old way, in every other respect as nearly alike as possible, and of the same metal, have been made and tested; and in every instance the hollow-cast gun has proved the better gun, in many cases showing a most marked superiority in strength and endurance.

The advantages of this system are not confined to superior strength. The hollow-cast guns have a harder and more close-grained metal for the surface of the bore, and it resists better the erosion of the gas and the action of the projectile upon it; and what is of great importance in times of emergency, when dispatch is important, the time of cooling the gun is much diminished, and the capacity of the foundery for work greatly increased. Notwithstanding these advantages, and the oft-repeated proof of its superiority, so great was the prejudice to be overcome, that it was only by dint of persistent effort that this mode of casting guns was adopted in 1859, some fourteen years after its first conception.

The course of competitive trials between the solid and hollow cast guns, which was carried on from 1848 to 1858, developed the fact that our heavy guns were seriously defective in endurance. In 1857 Captain Rodman commenced a series of elaborate experiments with a view of determining the causes of their failure. These experiments and their results are embodied in a most valuable work entitled "Report of Experiments on the Properties of Metals for Cannon, and the Qualities of Cannon-Powder," prepared by him, and published by the Ordnance Department. The book reflects credit upon its author and his country, and is known and appreciated by artillerists of every service. It placed Captain Rodman at once in the front rank of vigorous and original thinkers and investigators, and at the head of ordnance officers in this or any other country.

The cause of failure of our heavy ordnance was found in their defective model, the form of chamber, the mode of casting, and the improper powder used in them. A formula was worked out by which to shape the exterior model of all of our guns, a formula based on the law of the varying strain along the entire length of the bore, and disposing of the metal according to this law—something which had never before been attempted. The strain on the gun from different charges of powder and projectile was determined, as well as that from the same charge of powders differing in density and in size of grain. This was something which had never been attempted, and how to accomplish it was not an easy task. But Captain Rodman's resources were equal to the undertaking. The information was of great importance, and his inventive faculty readily devised the means for its determination in the "pressure-piston" known under his name. The results given by this instrument are of such value in artillery that all

of the principal European nations use it, or a slight modification of it, and in firing unusual charges the pressure resulting therefrom is now always a point to be noted.

From these experiments was deduced the principle, which is now adopted generally, that powder must be made to suit the gun in which it is to be used; for large and moderately long guns we must have a large-grained, dense powder. But Captain Rodman went a step further. He observed that the law of the evolution of gas from a charge of powder in the state of grains is just the reverse of what it should be in order to give the greatest velocity to the projectile with the least strain to the gun. To impart a rapid motion to any heavy body we first commence to move it slowly, and gradually increase the force as the inertia is overcome. The same course is necessary in giving motion to a heavy projectile. If the force be applied too suddenly, before the ball has had time to yield to it, there is danger of bursting the gun. When a charge of grain-powder is inflamed, the burning-surface is the greatest at the first moment of ignition, and decreases rapidly as the inflammation progresses. The evolution of gas is therefore greatest at the first moment of inflammation, and diminishes as the burning continues. This brings a great strain on the gun at the first instant of discharge, from the suddenness of the application of the force, without a corresponding effect on the velocity of the projectile. By way of correcting this erroneous constitution of the powder, Captain Rodman proposed to press such as was intended for heavy guns into large prisms, with a series of small cylindrical holes parallel to their axes and the axis of the gun. The inflammation would then commence on the surfaces of these cylindrical holes, and the evolution of gas at first would be small; but, as the burning continued, the surfaces on fire would rapidly increase, the impulse to the projectile would be gradually increased, and the motion accelerated till the ball reached the muzzle. Thus a high velocity could be given to the shot without subjecting the gun to an excessive strain. Powder made in this form was tried, with remarkable results. Experiments with it were witnessed by foreign officers, and it has been adopted since by both the Russian and Prussian governments, under the name of prismatic powder. "Rodman powder" would have been a better name, as recognizing the source from which it was taken, without offer of compensation of any kind.

General Rodman improved the ordinary power for large guns by pressing each grain into exactly the same shape, resembling a double convex button. The English government, long incredulous as to the advantages to be derived from large powder, has at length adopted this improvement, modifying slightly the shape of the grain, and now sings loudly its praises under the name of "pebble-powder."

The large guns in our service, constructed on the model proposed by Captain Rodman, have, as has been customary in all services, taken their name from the inventor, and by this, together with his peculiar mode of casting, he will be probably best known to the world at large; but it is by no means certain that he has, by this invention, rendered so great service to his country, or to the military service of the world, as by his improvements in gunpowder, for which he has received no recognition of any kind from any source.

It is generally known that guns have been made, from time immemorial, with a preponderance of the breech, and the desired elevation is given by a screw, on which the breech rests. Those who have stood by a gun when fired from a field-carriage, must have observed with what violence the breech is apparently forced down on the head of the elevating-screw. No one seems ever to have doubted the opinion universally received since the time when field-guns were first used, that it was necessary to have something to support the breech of the gun and prevent this. I remember distinctly the time when Captain Rodman first proposed to have guns made without preponderance, and to place the axis of the trunnions so as to pass through the center of gravity, contending that the breech would not move when the gun was fired. After expressing his views freely in advocacy of the proposed change, and observing the look of an officer, high in rank and in the estimation of all for his superior ability and attainments, indicative of anything but agreement and satisfaction with the novel views expressed, Captain Rodman, desirous of discussing the question and meeting his objections, inquired, "Why not?" The officer did not deign to give a reply, but turned his head with a supercilious sneer. With a calm dignity of manner, Captain Rodman merely replied, "But, major, that is not an argument." Soon after the occurrence of this incident came on the war, and, with a greater infusion of young ordnance in the councils of the Department, the change just spoken of became an accomplished fact, and now all of our heavy guns are constructed so as to be balanced on their trunnions.

General Rodman's valuable services to the country during the war were rendered in the command of the Watertown arsenal, the capacity of which he vastly enlarged by the erection and equipment of large and well-ordered shops for the manufacture of field and sea-coast carriages. His labors were incessant, the work going on day and night by a relay of hands. Twelve and one o'clock at night often found him in the shops expediting the work. Even the first day of the week—the blessed day of rest to the weary—found him in his office with his masters, planning work or improvements for the coming week.

This close attention to his duties and want of rest and recreation brought on, in the summer of 1864, a severe fit of illness, which lasted for two and a half months, and was near terminating his career of usefulness.

In the summer of 1865 General Rodman was transferred to the command of Rock Island arsenal. This new station at once felt the influence of his enlarged views and his energy of action. A new plan for a combined arsenal and armory, on a scale of colossal proportions, was proposed, the appropriation obtained, and soon work was vigorously commenced to carry it into effect. The care and responsibility attending such work, and the incessant labor with which it was accompanied, particularly to one who attended so much to detail as he did, began to tell on a constitution already weakened by previous excessive labor, and he was warned by his physician of the absolute necessity of his taking a leave of absence for the sake of rest and recreation. But he was interested in his work, took a pleasure in seeing his plans carried out in his own way and under his own supervision; he was busied about that which was to be a monument to him for ages, to tell of his ability in planning and his skill in constructing, and he neglected to heed the wise counsel until it was too late.

Fairly broken down by the heavy weight he had been carrying, his strong physique, which with care might have lasted for many years to come, yielded to the incessant demands made upon it, and when only a little past the prime of life his career of usefulness was abruptly terminated, and his work brought to a premature close. This work speaks for the man, telling of his comprehensive grasp of mind, of his originality of thought, of his fertility in invention, of his prudence and caution, and proclaiming him a profound investigator who looked deep into first principles. His mind was not of that brilliant order which startles by its flashes, and seems to reach its conclusions intuitively or by a single leap, but was of that slower, more deliberate kind which proceeds step by step, examining well each position taken before advancing to the next. When the conclusion is reached, the ground has been so closely reasoned and so firmly established that it is not lightly shaken.

General Rodman has acquired for himself a name which will be known as long as the history of artillery shall be written and handed down, and will be inscribed and honored along with those bright lights of ballistic investigation of the last century, Rumford and Robbins.

CHAPTER VIII.

HISTORY OF THE ARSENAL DURING MAJOR FLAGLER'S COMMAND, FROM JUNE, 1871, TO DECEMBER, 1876.

(Includes Appendixes A to G.)

Time embraced in and contents of chapter—Captain Flagler placed in command—General statement of work of construction accomplished—Detailed statement of work done, including dates of erection of buildings, planting of trees, &c.—Plans and site for magazine approved—Plans and sites for laboratories and more magazines recommended and approved at the same time—Statement of general plan for these buildings—Site selected and plans approved for subaltern officers' quarters—Plans and site for soldiers' barracks approved—Description of the building—Plans approved for post building to contain main guard-house, fire-engine house, &c.—Correspondence respecting site for this building—Site selected by Chief of Ordnance—Description of this building—Difficulty encountered in procuring stone in sufficient quantities—Plans adopted for Main, Rock Island, and Fort Armstrong avenues, and Arsenal railroad—Reasons for plans—Plans adopted for Shop E—Account of construction of same—Difficulty in procuring suitable iron for roof-frame—Full history of same, records of tests, &c.—Plans for boiler-house, chimney, engine-room, &c., for Shop C adopted—Shop-fixtures for Shop C—Account of construction contained in Appendixes B and C—Moline bridge—Account of construction of piers and abutments in 1870—Erection of superstructure delayed—Reasons for—Pledge from citizens of Moline about use of bridge—Appropriation for completing bridge, by Congress, in 1872—Description of bridge and account of its construction—Completed in May, 1873—Extract from annual report—Visit of General Benét, Chief of Ordnance, to arsenal in May, 1875—Action taken by him—Decision to commence fabrication of stores—Other arsenals broken up and stores transferred to Rock Island—Act of Congress to establish a military prison at Rock Island—Account of same in Appendix G—Correspondence about plans for rolling-mill—Full statement of bad effects of law prohibiting expenditure of balance of appropriations remaining on hand at end of fiscal year—Attempts made to obtain relief from action of the law—Action taken by Chief of Ordnance and Secretary of War—Failure to obtain relief.

APPENDIX A—Annual report of principal operations at the arsenal for the year ending June 30, 1872—Appropriations available April 20, 1871—Work on the water-power—Construction of canal and stone dike—Controversy with the Moline Water-Power Company—Enlargement of the canal—Suspension of work on account of cold weather—Work on Shop B—Work on Shop C—Pavement for basement of shops—Commencement of work on Shop D—Report of Lieut. Charles Shaler on foundations of Shop D—Work on Shop E—Grades of streets, avenues, and grounds—Boiler-house and chimney for Shop C—Officers' quarters—Sewers—Work done on avenues and roads—Work done on Rock Island wagon-bridge—Other work accomplished.

APPENDIX B—Annual report of principal operations at the arsenal in the year ending June 30, 1873—Description of work done on canal wagon-road bridge—Work done on water-power canal—Difficulty with mill-owners using water-power—Work done on the Sylvan water-dam—Difficulty of obtaining good foundation—Breaking of Sears's dam—Causes of deposit in water-power pool—Danger of complete stoppage of water-power by deposit and ice combined—Work done on Shop D—Hood put on Shop E—Fixtures for Shop C—New engine commenced running—Building of barracks—Description of exterior and interior—Magazine completed—Moline bridge—Rock Island bridges—Track laid on it—Description of draw and difficulty in working it—Building of Arsenal railroad—Description of Fort Armstrong avenue—Rock Island avenue—Main avenue—Difficulty of maintaining regulations controlling public on Rock Island bridge—Effect upon operations at arsenal of law of July 12, 1870, relating to unexpended appropriations—Report of Lieut. Charles Shaler, jr., upon the ice-gorge and breaking of Sears's dam.

APPENDIX C—Annual report of principal operations at the arsenal in the year ending June 30, 1874—Work done on Shop D—Insufficient supplies of stone received—Stone purchased in open market—Work done on Shop A—Shop-fixtures for Shop C—Work done on Shop E—Saving effected by manufacture of iron-work by United States—Brass-foundery—Work done on post-building—Subaltern officers' quarters—Paving basements of Shops B and C—Improvement of grounds—Rock Island bridge—Strike of stone-cutters—Bad effects of law prohibiting expenditure of balance of appropriations remaining on hand at close of year—Special report to Chief of Ordnance about strike of stone-cutters.

APPENDIX D—Annual report of principal operations at the arsenal for the year ending June 30, 1875—Work done on Shop D—Saving in cost of roof-frame—Work done on Shop A—Work done on Shop F—Foundations of Shop F—Excavations for same—Difficulty encountered in obtaining satisfactory foundation—Work done on water-power—Water-pipe laid—Repairs of reservoir—Manufacture of water-pipe—Filtering-cisterns in the river—Roads built—Improvement of grounds—Work done on Rock Island bridge—Difficulty about appropriation for same.

APPENDIX E—Annual report of principal operations at the arsenal for the year ending June 30, 1876—Work done on Shop A—Saving effected by not contracting brick-work, copper-work, &c.—Work done on Shop F—Alteration of entablature—Manufacture of machinery for transmitting power to shops—Completion of work prevented by law prohibiting expenditure of balance of appropriations remaining on hand at end of year—Manufacture of water-wheels—Selection of pattern—Improvement of grounds—Care and preservation of buildings—Description of iron fence—Cost of same—Work done on Rock Island bridge—Accident to draw—Bridge statistics.

APPENDIX F—Copies of all acts of Congress making appropriations for Rock Island arsenal from 1871 to 1876.

APPENDIX G—Location of military prison—Act of Congress proposing to locate prison at Rock Island—Letter of Captain Flagler to Chief of Ordnance stating objections to location of prison at Rock Island—Indorsement of Chief of Ordnance—Letter of Adjutant-General of the Army appointing members of board on prison—War Department special orders making change in board—Meeting of board—Letter of Captain Flagler to president of board giving reasons why prison should not be located at Rock Island—Extract from report of preliminary board of officers to select site—Board dissolved and new board appointed—Act of Congress locating prison at Fort Leavenworth.

This chapter gives an account of the prosecution of the work of constructing the arsenal and armory and the improvement of the island, from the time of General Rodman's death till December, 1876. It also includes an account of the construction of the arsenal wagon-bridge to the city of Moline, known as the Moline bridge, but gives no history of the Rock Island bridge and the water-power. These last two subjects will be taken up in separate chapters further on, viz, Chapters IX and X, respectively.

I was placed in command of the arsenal by the following order:

[Special Orders No. 233.]

[EXTRACT.]

WAR DEPARTMENT, ADJUTANT-GENERAL'S OFFICE,
Washington, June 15, 1871.

On the recommendation of the Chief of Ordnance, Captain D. W. Flagler, now on duty at Rock Island arsenal, is hereby assigned to the command of that post.

By order of the Secretary of War.

WILLIAM D. WHIPPLE,
Assistant Adjutant-General.

The progress which had been made in the work of constructing the arsenal prior to this time has been already stated in Chapter VII. The work which has been done since is as follows: (See map on Plate VI.)

Shops E, D, and A have been entirely built.

Shops B and C have been completed.

Shops F and G have been begun, and F nearly completed.

The commanding officer's quarters have been completed.

Three other stone buildings, (*b*, *c*, and *d*,) for subaltern officers' quarters, have been built.

The soldiers' barracks, one post-building, (for main guard-house, fire-engine house, commissary and quartermaster store-houses and offices,) and one powder-magazine have been built.

The pump-house for the water-works, the entrance-gates and guard-house, and the post ice-house have been built.

A complete system of sewers for the shops and adjoining buildings, and separate sewers for the barracks and the row of officers' quarters have been built.

An 8-inch water-main, supplied with fire-plugs and branches to the buildings, has been laid from the reservoir around the site of the shops, and an 8-inch supply-main to the proposed site of a large pump, to be driven by water-power, near the water-power dam.

A large amount of work has been done in the construction of the arsenal roads, streets, avenues, and system of railroads, in laying stone walks, in planting trees, and in grading and improving the grounds. This part of the work is rather more than three-fourths completed.

The Moline bridge has been built.

A full history of the construction of these buildings and of the other work done, including the work on the water-power and the Rock Island bridge, was sent to the Chief of Ordnance each year in the annual reports of the principal operations at the arsenal from 1872 to 1876. These reports are copied in appendixes to this chapter, and are marked "A," "B," "C," "D," and "E."

Following is a condensed statement of the dates at or between which the different buildings were erected, and a short statement or description of the other work done, except that on the water-power and Rock Island bridge, a separate and full account of which is given in Chapters IX and X. (See map on Plate VI.)

Shop E was begun in 1871 and finished in 1874. The two cupola-furnaces and other foundery-fixtures, and the blacksmiths' forges, chimneys, steam and power hammers, and other forge shop fixtures were put into this building and the shop fitted up for use as a foundery and forge-shop in 1873 and 1874. The shop has been in full use in manufacturing the roofs, columns, and all the iron and brass work used in constructing buildings at the arsenal, and in manufacturing stores for the Army since 1874.

Shop D was begun in 1871 and finished in 1875.

Shop A was begun in 1873 and finished in 1876.

Shop F was begun in 1874 and is now nearly completed. The walls are completed, the iron roof-frame is completed and put up, and the doors, window-frames, and sashes are completed and ready to be put in. Much of the filling up and grading required around the building has been done.

Shop G was begun in 1876. The excavations for the foundations, basement-story, and area between the wings of this building have been made, the foundations put in, and a part of the area-walls built. Only the small appropriation of $30,000 was made for this building.

Shop B was begun in 1867, and was completed in 1872. The only work done on this building since June, 1871, (during my command,) is as follows: The painting of the wood and iron work, the paving of the basement, the construction of the iron stairways, the outside stone steps and platforms, and a portion of the area wall and slopes; the grading and paving of the area between the wings, and the grading and laying of walks and the building of roads around the building.

Shop C was begun in 1867 and completed in 1873. The work done on this building prior to June, 1871, consisted in building the walls and putting up the iron roof-frame. The boiler-house and chimney-stack were added to this shop in 1872, and the boilers, steam-engine, shop fixtures and machinery, both for iron and wood working, were put in the building fully fitted up and made ready for use in 1872 and 1873. It has been in full use in preparing the wood and metal work required in the construction of buildings, in manufacturing shop fixtures and machinery, and in fabricating stores for the Army since 1873. The shops for leather and equipment work, and repairs of small-arms, were fitted up in the same building in 1875 and 1876.

The commanding officer's quarters were begun in 1870 and finished in 1871. Prior to June, 1871, the walls and roof of this building had been completed, and the interior work was far advanced. The grading, laying out of the grounds, and planting of young trees around this building were done in the spring of 1872.

The two sets of officers' quarters *c* and *d* were built in 1871 and 1872, and the set *b* was built in 1873 and 1874. The trees around these buildings and along the road in front of them were planted in 1873, 1874, and 1875. The trees and hedge along the road in their rear were planted in 1876.

The soldiers' barracks were built in 1873 and 1874. The trees in front of this building were planted in 1874.

The post building, containing the main guard-house, fire-engine house, and quartermaster and commissary store-houses and offices, was built in 1873 and 1874.

The powder-magazine was built in 1872 and 1873.

The pump-house, on the river-bank, in front of the row of officers' quarters, was built in 1875, and the steam boiler and pumps were put in it in the same year.

One of the steam-pumps was manufactured in the arsenal shops.

The post ice-house, shown on the map, was built in 1871. The capacity of this building is sufficient for the probable future wants of the arsenal.

The entrance-gates and guard-house, at the intersection of Rock Island and Main avenues, were built in 1875.

The Moline bridge was built in 1872 and 1873, and a full, separate history of this work is given further on in this chapter.

The lines of the sewers for the shops, adjoining buildings, streets, and avenues, are shown on the map. These sewers were built in 1871.

The lines of the water-mains are also shown on the map. These were laid at various times from 1872 to 1876, and much of the pipe was manufactured in the arsenal foundery.

The following roads, avenues, and streets have been built during the years from 1871 to 1876: Main avenue, from the point where it is intersected by Second street, to the approach to the bridge to Davenport; Rock Island and Fort Armstrong avenues; West avenue, from Main avenue nearly to its south end; East avenue; North avenue; the west half of South avenue, and First and Second streets. These streets and avenues are graded, then covered with from 10 to 14 inches of finely-broken rock, and then 6 inches of gravel. Where grades require it, they have paved gutters at the sides. The total length of these avenues and streets built is 3¾ miles.

The arsenal railroad, from its junction with the track of the Chicago, Rock Island and Pacific Railroad to the prolongation of the line of South avenue, and along that line and along South avenue, and the railroad embankment in the river at the junction of the two tracks, were built in 1872. This is the only arsenal railroad now built, except some sidings along South avenue.

The grounds at the west end of the island were graded and the trees there were planted in 1875.

The trees along both sides of Main avenue, from the entrance-gates eastward to the foot of the high grounds, were planted in 1876; those around Shop B were planted in 1871; those around Shop A in 1875, and those around Shops C and D in 1876.

The road in front of the row of officers' quarters was built in 1873 and 1874, and the one in the rear of the same in 1876.

The stone walk along the front of the row of officers' quarters and that along West avenue to the shops were laid in 1873 and 1874. The walks along the east side of Rock Island avenue and along the north side of Main avenue were laid in 1875 and 1876.

Besides these, stone walks have been laid along First and Second streets, and the necessary walks in front of and around Shops A, B, C, and D. These are the only walks that have been laid. Their total length is 3 miles.

The iron fence in front of the row of officers' quarters was built in 1876.

The grading, paving, laying of walks, and similar work around the shops (not noticed here) was done generally in the years in which the shops were finished.

A full history and description of all the foregoing work is given in the annual reports for the years in which the work was done, which are appended to this chapter.

The following is a statement of all the appropriations and expenditures for the arsenal from 1871 to 1876, during which time the foregoing work was performed:

Funds appropriated for, received, and expended at Rock Island arsenal from June 1, 1871, to December 31, 1876.

Fiscal year ending June 30—	Acts of Congress approved—*	Amounts appropriated.	Amounts received.			
			From the United States Treasury.	From sales.	By transfers.	Total.
1872	March 3, 1871	$688,000 00	$688,000 00	$151 50	$1,353 32	$689,504 82
1873	June 10, 1872	752,000 00	771,690 43	.....	1,143 25	772,833 68
1874	March 3, 1873	554,100 00	574,100 00	.....	.....	574,100 00
1875	June 23, 1874	400,150 00	444,150 00	.....	.....	444,150 00
1876	March 3, 1875	309,500 00	275,500 00	.....	.....	275,500 00
To Dec. 31, 1877	July 31, 1876	136,000 00	108,000 00	.....	.....	108,000 00
		2,839,750 00	2,861,440 43	151 50	2,496 57	2,864,088 50
	Amount on hand May 31, 1871	.....	.....	.....	.....	99,130 69
	Total	.....	.....	.....	.....	2,963,219 19

* The several acts of Congress referred to here are copied in Appendix F to this chapter.

Fiscal year ending June 30—		Expenditures.				
		For construction of buildings and other arsenal work.	For Rock Island water-power.	For Rock Island bridge.	Refunded in the United States Treasury.	Total.
June 1 to June 30, 1871	Disbursements	$54,379 70	$15,965 08	.....	.....	$70,344 78
1872	....do	472,908 51	180,136 19	.....	$151 50	653,196 20
1873	....do	624,498 65	106,619 59	$2,730 73	.....	733,848 97
1874	....do	546,187 89	11,945 05	4,072 06	30,000 00	592,205 00
1875	....do	411,272 78	21,629 39	16,488 55	.....	449,390 72
1876	....do	247,289 94	10,511 50	29,885 62	.....	287,687 06
To Dec. 31, 1876	....do	119,217 83	4,404 67	8,822 55	.....	132,445 05
		2,475,755 30	351,211 47	61,999 51	30,151 50	2,919,117 78
	Amount on hand December 31, 1876	.....	.....	.....	.....	44,101 41
						2,963,219 19
	Outstanding indebtedness December 31, 1876	12,097 05	.....	1,345 23	.....	13,442 28
		2,487,852 35	351,211 47	63,344 74	.....	2,902,408 56
	Outstanding indebtedness incurred prior to June 1, 1871, and paid after that date, to be deducted	29,899 11	3,000 00	.....	.....	32,899 11
	Total cost of work done from June 1, 1871, to December 31, 1876	2,457,953 24	348,211 47	63,344 74	.....	2,869,509 45

Recapitulation of cost of work done at Rock Island arsenal from 1863 *to* 1876.

	Construction of buildings and other arsenal work.	Rock Island water-power.	Rock Island bridge.	Total.
Under Major Kingsbury	$231,384 72			$231,384 72
Under General Rodman	1,855,455 62	$440,506 35	$6,664 33	2,302,626 30
Under Major Flagler	2,457,953 24	348,211 47	63,344 74	2,869,509 45
Total	4,544,793 58	788,717 82	75,009 07	5,403,520 47

Papers, correspondence, and facts relating to the foregoing work, which have not been included in annual reports; explanation of map on Plate VI; sites and plans adopted for various buildings shown thereon, and other history of Rock Island arsenal between June, 1871, *and December,* 1876.

POWDER-MAGAZINE.

There is shown on the map on Plate VI only one complete magazine. This is the one built in 1872 and 1873. The site of this building was selected while the Chief of Ordnance (General Dyer) was at the arsenal in October, 1871, and its location is part of a general plan for other magazines and laboratory-buildings, which was fully discussed and approved by the Chief of Ordnance at that time.

There are shown, near the completed magazine, two other similar magazines. These and the one built are intended for the storage of fixed ammunition only, and as many can and should be erected at this point as the wants of the arsenal may demand. It is thought that two more like the one already built will be sufficient. From these magazines a road is already built northward to Main avenue, and where this road crosses the arsenal railroad a side track is to be provided where cars can be loaded with ammunition.

On a high ridge of ground near the south end of West avenue is shown site for the laboratories. These are to be connected with the ammunition-magazines by a good road separated from the other business of the arsenal. None of the laboratories have been built; but there are now at this point two temporary wooden buildings, erected in 1874, in which the limited amount of laboratory-work required at the arsenal thus far has been performed. The laboratory-buildings should be light wooden structures with iron frames, like those at the Frankfort arsenal, and of such capacity and number as the wants of the arsenal shall demand. They would be used for *fixing* ammunition only, and the limited amount of power required can be supplied by one wire-rope running from the upper story of Shop A. The artillery-projectiles are to be cast in the arsenal foundery, (Shop F,) and the projectiles, bullets, cartridge-cases, and other materials required at the laboratories (except powder and fuses) are to be prepared in Shop A and hauled to the laboratories via West avenue.

It is not intended that any considerable amount of powder will ever be stored at the arsenal. Safety demands that it should be stored at the powder-depot. There are shown two small powder-magazines, widely separated from the other buildings and from each other, and located in open spaces in the woods on the high ground south of Main avenue toward the east end of the island. The estimated capacity required for these magazines is about 1,200 barrels each. At times when the arsenal is in full operation it should be supplied with a powder-

barge of about 1,000 barrels capacity, manned or guarded by a detachment of enlisted men, to be towed between the powder-depot near Saint Louis and the excellent landing on Benham's Island, near the east end of the island, (see map on Plate VI,) and from there the cargoes to be hauled to the powder-magazines. Powder received in cars would be run to a siding east of East avenue, and from there hauled to the magazines. The powder would be hauled from the magazines to the laboratories in covered carts via the road along the south shore of the island.

These plans embrace full facilities for all the laboratory-work that can ever be required, prevent the necessity for hauling or handling any powder in the vicinity of the important buildings, and locate all the buildings with the utmost convenience compatible with the necessary safety.

This general plan was examined and approved by the Chief of Ordnance, in connection with the selection of a site for the one magazine to be built, while he was at the arsenal in the fall of 1871. It has been shown on most of the maps at the arsenal made since that time; but, as it has never been the subject of any official correspondence, it is deemed important that it should be explained and recorded here.

SITE SELECTED FOR SUBALTERN OFFICERS' QUARTERS.

The site selected for these buildings is shown on the map on Plate VI. The six buildings between East and West avenues are placed in pairs, with wide intervals between the pairs, in order that, if the wants of the arsenal should in the future demand it, additional quarters may be placed in these intervals. It was thought that the line was long enough to furnish room for all the quarters that might ever be required.*

It will be observed that this row of quarters is not parallel or perpendicular to any of the other lines of construction followed at the arsenal.

I have never known what were General Rodman's plans respecting sites for the quarters. When the sites for the shops were fixed it was intended that the officers' quarters should be placed fronting West avenue, in a row along the east side of that avenue; and I do not know that he changed his views respecting this. During General Rodman's illness in the spring of 1871 Captain Comly, while in charge of the arsenal, prepared plans for two sets of quarters, and sent them to the Ordnance Office, and recommended that they be placed nearly on the ground subsequently selected, but on a line perpendicular to West avenue. The Chief of Ordnance, Brig. Gen. A. B. Dyer, did not object to the site but thought that, if it were selected, the buildings should be placed in a row perpendicular to West avenue. When I was assigned to the command of the arsenal the site had not yet been selected. The one finally chosen, on the crest of the high ground fronting and overlooking the river, was certainly the best and most suitable one. The line of the crest of this high ground is not perpendicular to the avenues; and if a perpendicular line had been followed, (which in some respects was very desirable,) it would have thrown the buildings at one end of the line down into the bottom land, or those at the other end back behind the high ground, cutting them off from a view of the river. This matter was the subject of a good deal of discussion. The approval of the

* If the arsenal were completed and necessity should compel its use to its full capacity, I believe that the operations would be of such magnitude as to demand the services of from fifteen to twenty officers.

Rock Island bridge connecting Rock Island and Davenport, and you will please select a site for it accordingly, and give your views for and against such a location."

The accompanying map shows also the location of the barracks and stables. The efficient service of the fire-engine requires that it be kept near to both the barracks and the stables. The site proposed is in harmony with the arrangement of other buildings, and is the only suitable site that is near enough to the buildings mentioned.

The detachment of ordnance, and the horses for hauling the engine, are required for the service of the engine. If the engine-house is too far from the barracks and stables, the value of the engine is always diminished, and would sometimes be entirely destroyed. The inconvenience arising from widely separating the barracks and guard-house is as apparent, though not so important.

An important part of the duty of the guard is to maintain order and dicipline in the barracks. From the site proposed this can be done by the main guards. From any other available site a separate guard, of a non-commissioned officer and three men, would generally have to be kept at the barracks.

For convenience in feeding the guard and prisoners, the easy arrest and confinement of men, and the supervision of the officer of the day, when not required to stay at night at the guard-house, makes it desirable and important that the buildings should be near the barracks.

Many of the same reasons for placing the building near the barracks hold good in respect to the commissary and quartermaster's store-houses.

If the Department still desires that the building be placed on Main avenue, between the shops and the city of Rock Island, the best site for it, and the only one suitable, is the one marked "C." This site is about 2,500 feet—nearly ½ mile—farther from the barracks and stable than the other one proposed. The only objection to it is its great inconvenience. If it were selected, I think that then the office ought certainly to be located at the point marked "F." The only advantage of this arrangement would be that the symmetry of arrangement of buildings and good appearance of the arsenal would be thereby greatly promoted, and on this account it would be very gratifying to me to build accordingly. The inconvenience of the arrangement is, however, so considerable that I am unwilling to recommend it. It is presumed that a principal reason for recommending that the building be placed between the shops and the Rock Island bridge is because it is generally advisable that the guard-house be between the entrance and the other arsenal buildings. This reason does not hold good in this case.

There are three principal approaches to the arsenal, viz, via the bridges from Moline, Rock Island, and Davenport, and there will be, eventually, another, from the wharf. When visitors have crossed there, there are a great many roads open to them, and they approach the shops and other buildings from all directions, and by as many as a dozen different roads, streets, and avenues. Only loaded teams are confined to the avenues. The main guard-house must be located near the principal buildings, and not only furnish sentinels for the buildings and grounds adjacent, but, at times, watchmen and detached guards for distant parts of the island. The use of the lower end of the island by the public renders it necessary that a fence be built along the east side of Rock Island avenue to Main avenue, and thence directly to the river bank, as shown by a red dotted line on the map, with entrance-gates where it crosses Main avenue. All persons approaching from Rock Island and Davenport must then pass through these gates. It was partly for this purpose that Main, Fort Armstrong, and Rock Island avenues were planned as they are, and this plan was approved last year. A small entrance guard-house, marked "K," should then be placed at the gates, with two rooms for temporary confinement of persons arrested in the enforcement of regulations of the bridges. At this guard-house would be kept a guard of one non-commissioned officer and three men.

I have endeavored to state fully and carefully everything relating to this subject, and particularly to state fully every objection to the site for guard-house, &c., suggested in your letter, in order that, if my judgment is not concurred in, you may be sure that no objections with which you are unacquainted will appear hereafter.

Respecting the building itself I have to state that it has been planned with reference to the future of the arsenal. In the future, and particularly in time of war, a garrison of 200 men will probably be kept at the arsenal. The barracks have been built for that number of men. At such times the main guard would be a large one, and the officer of the day or guard would be required to spend the night at the guard-house, and a room has been provided for that purpose.

The walls of the building are to be of stone, heavy range rubble, with cut-stone entablature, caps, sills, water-table, and jamb-stones. The pilasters are to be of ashlar. The architecture is very nearly the same as that of the shops, though I have been forced to reduce greatly the cornice and architrave, and expense in other parts of the building, to bring its cost within the appropriation.

A cellar (not shown in the drawings) for commissary-stores is to be placed under the commissary and quartermaster's wing of the building.

The prison-rooms are to be warmed by warm air from the guard-room passing through a grating near the ceiling, and ventilators communicating with flues in the chimney carry cold and foul air from the floors. A cross-section and elevation of prison-rooms is inclosed. I have taken some pains to carry the chimney-flues up in the walls of the hose-towers, to increase the circulation of air through the towers and to afford warmth to aid in thawing ice off hose in winter.

Very respectfully, your obedt. servant,

D. W. FLAGLER,
Captain of Ordnance, Bvt. Lieut. Colonel, U. S. A., Commanding.

For drawings transmitted, see Nos. 381, 382, 383, and 384, Ordnance Office and Rock Island files.

The following reply was received thereto:

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, July 3, 1873.

COMMANDING OFFICER,
Rock Island Arsenal, Rock Island, Ills.:

SIR: I am instructed by the Chief of Ordnance to inform you that the Secretary of War has approved the plans for the new guard and engine house as submitted by you, but directs that they shall be so modified as to place on the first floor a bath-room and water-closet for the use of the guard and prisoners; a water-closet for the use of the watchmen and men employed for the service of the steam-engine; hoisting and heating apparatus complete, (for which you do not seem to have estimated;) a water-closet on the 2d floor for the use of officers; and gas-pipes to be put in the walls to which fixtures can hereafter be attached.

The appropriation of $27,500 must not be exceeded in making the building thus complete. The building will be located on the Main avenue at a point designated on the tracing of the arsenal (marked "Rock Island Arsenal, No. 384") sent with your letter of May 17, 1873, as "C."

The approved plans herewith returned to you will be sent back to this office as soon as tracings thereof have been made by you.

Respectfully, your obedient servant,

S. C. LYFORD,
Capt. of Ordnance, Principal Assistant.

The following reply thereto was sent:

ROCK ISLAND ARSENAL, ILLS.,
July 12, 1873.

THE CHIEF OF ORDNANCE,
U. S. Army, Washington, D. C.:

SIR: I have the honor to return herewith drawings of a new fire-engine house, guard-house, and commissary and quartermaster's offices and store-houses, to be built at this arsenal, with arrangement and location of bath-room and water-closets marked thereon.

The heating-apparatus designed for this building consists of large coal-stoves, to be taken from temporary buildings no longer required. The arrangement of smoke-flues, chimneys, and ventilators is shown on drawings, and mentioned in my letter of May 17, 1873. Estimates for these are included in brick-work.

An estimate for sewer and water pipe to this building, rendered necessary by the introduction of water-closets, will be included in annual estimate for next year.

Water-pipes, to be safe from frost, must, at this post, be laid six feet under ground. The excavation is nearly all in rock, and extensive.

Alterations in red ink, showing location of bath-room, water-closets, sink, and sewer-pipe, were made July 11, 1873, authorized by letter of Chief of Ordnance, dated July 3, 1873.

Very respectfully, your obedt. servant,

D. W. FLAGLER,
Captain of Ordnance, Bvt. Lieut. Col., U. S. A., Comdg.

The walls of this building and of one of the sets of subaltern officers' quarters (marked "*b*" on map) are built of stone obtained from quarries at Anamosa, Iowa. The stone is excellent in quality, durability, and appearance; but the capacity of the quarries at Anamosa and facilities for transportation were rather limited at the time these buildings were erected, and much difficulty was experienced in procuring the stone as rapidly as required.

The contract for the rubble and pilaster blocks was awarded to Martin Heisey, of Anamosa, Iowa. The quarry from which the stone was taken is known as the Iowa State quarries. The stone was quarried by the convicts confined in the penitentiary at Anamosa. The price of the stone delivered on cars at the arsenal was $8 per cubic yard.

The dimension-stone was ordered from J. A. Grau, of Anamosa, Iowa. The price was $12.40 per cubic yard delivered on cars at the arsenal. Both of the contractors were slow in furnishing the stone of the quality and in quantities as agreed upon. They had considerable difficulty in obtaining transportation, and when obtained it was very costly. When the contracts were first made, the Davenport and Saint Paul Railroad Company had an arrangement with the Chicago, Rock Island and Pacific Railroad Company, by which the cars of the former were run to Davenport over the track of the latter road from a point a few miles from Davenport; but before all the stone was delivered the connection between the two roads was broken up, and the Davenport and Saint Paul Railroad Company ran its trains to a station called Duck Creek, about five miles from the arsenal, and from this time all stone was transported by teams from the terminus of the road to the arsenal. This arrangement was expensive and unsatisfactory. The contractors claim that they lost money. It is highly probable that they did not make any profit. A man had to be kept constantly at the quarries to inspect the stone and urge shipments.

THE ARSENAL RAILROADS, MAIN, ROCK ISLAND, AND FORT ARMSTRONG AVENUES.

The plans for these were made in the winter of 1871 and 1872, and were approved by the Chief of Ordnance while I was in Washington during the same winter. As these plans were explained and discussed verbally only, there is nothing on record respecting them except the map. (The only part of Main avenue referred to here is the part lying west of the arsenal shops. The part lying east of the shops was built some years before.)

I do not know and do not think that any location for Main avenue or the arsenal railroad had been definitely fixed upon prior to this time. I found at the arsenal several maps on which the avenue, or more generally only the eastern part of it, was located in different places. The timber had been cut away and some work done on one of these routes, but when it became necessary to connect this route with plans for the railroad and avenues to the bridges to Rock Island and Davenport, it was nearly impracticable. The route for the arsenal railroad, shown on the old map, was to have it curve to the north and connect with the track of the Chicago, Rock Island and Pacific Railroad near the end of the bridge over the main channel. The objections to this plan were serious. Most of the railroad business with the arsenal is from the south or Illinois side. Trains from the Illinois side would have to run over the switch, stop and back, to get on to the arsenal track; and this stopping and backing would be over the island approach to the bridge, on the bridge, and, worst of all, on the draw of the bridge. For safety as well as convenience, it was necessary to avoid this. Careful surveys* were made to ascertain whether the switch might be placed far enough south of the end of the bridge and draw to leave room for trains to get on the arsenal track without running onto the draw.

*These surveys, and the other surveys required for the railroad and avenues, were made by Lieut. Charles Shaler, Ordnance Department, and I am much indebted to this officer for assistance in making plans for this work.

This was hardly practicable, and in any case gave a sharp curve to the railroad, and threw the track far over into the low ground near the south channel. It also cut off all practicable routes for an avenue to Rock Island City, except the long route around by Fort Armstrong past the entrance to the bridge to Davenport. By turning the switch the other way, as it is now built, a heavy additional expense had to be incurred for building the railroad-embankment into the south channel, but all the difficulties described above were avoided. The railroad was brought by an easy curve to the prolonged line of South avenue and located on that line. The most important consideration was, that this arrangement permitted the extension of Main avenue in a straight line down through the island without any railroad-crossings, gave an excellent and easy avenue to Rock Island, also without railroad crossing; made both these avenues the handsome addition to the arsenal that they are, and gave a fine and rather imposing view up Main avenue from the cars on the Chicago, Rock Island and Pacific Railroad.

The early maps of the arsenal locate the Arsenal Railroad between East and West avenues along Main avenue. These tracks were changed to North and South avenues when the above plans were made. As the courts of the shops open on North and South avenues, hauling to and from the shops will naturally be confined to these avenues, and the railroads should be on them. This arrangement leaves Main avenue a handsome boulevard. The width of North and South avenues, as shown on the map, was increased at the same time.

The railroad-track to North avenue will only be required when the armory is in full operation, and as little or no grading is required for this track, it can be laid in a few days.

SHOP E.

In June, 1871, I went to Washington to confer with the Chief of Ordnance respecting plans for and the prosecution of work at the arsenal. At that time drawings showing the proposed elevation for Shop E were taken to Washington, submitted to the Chief of Ordnance, and were approved by him. (Drawing No. 333, Ordnance Office.) Shop E is the forge-shop and foundery for the arsenal; and the plans which had been adopted previously required that this shop, which was to be the center shop of the arsenal row of shops, and Shop F, which was to be the forge-shop and rolling-mill for the armory and also the center shop of the armory row of shops, were to have the same ground-plan as the other shops and to be only one story high; but the elevation and thickness of walls had not been fixed. It was determined at the same time to put peak-hoods on these two shops for ventilation and for conducting away smoke.

By advertisement dated April 12, 1871, proposals were invited to furnish stone for Shops D and E, and resulted in awarding the contract, in June, 1871, to W. A. Steel, of Joliet, Ill., at $11.85 per actual cubic yard of stone-work in the building when completed, excluding all openings and all builder's or other technical or constructive measurements. For specifications, see contract dated June 3, 1871.

The roof-frame for Shop E was procured from Messrs. Carnegie & Kloman, by contract dated August 14, 1871. Much difficulty was experienced in procuring iron of suitable quality for the roof-frame, as is shown in the annual reports for the years that the work was in progress. (See Appendixes A and B to this chapter.) The iron was furnished by Messrs. Carnegie & Kloman from their works in Pittsburgh, and was shipped to N. S. Bouton & Co., of Chicago, who manufactured the roof-frame and shipped it to the arsenal.

Under date of August 14, 1871, Messrs. Carnegie & Kloman, in reply to a letter from me dated August 8, 1871, wrote as follows:

We acknowledge receipt of your valued favor of 8th instant. We return this day quintuplicate copies of our contract by mail to Messrs. N. S. Bouton & Co., who will forward same to you. Please communicate with them direct, and this will expedite matters; they will perform the contract for us. Our agents will write you further in reply to your letter, which we will mail to them.

The rejection of the iron offered for this roof produced some controversy. A portion of the correspondence on the subject illustrates the difficulty usually experienced in procuring iron of the high grade required for roof-frames, and, with the records of tests, is copied here.

The first samples of the iron were received in July, 1872. These were manufactured rods ready for use. Some of them were at once tested, with the following results:

Tests of iron for roof-frame of shop E.

Common rafter.	Diameter of rod.	Turned down to diameter.	Diameter of rupture.	Breaking-weight in pounds per square inch of rupturing diameter.	Breaking-weight in pounds per square inch of original diameter.	Character of fracture.
Rod A, weld specimen	1¼″	.8″	.722	53, 787	45, 439	Fibrous, with irregular circles near center; imperfect welds.
Rod A, middle of rod	1¼	.8	.660	83, 160	56, 600	Dull fibrous.
Rod B, weld specimen	1⅛	.8	.791	38, 299	37, 442	Broke in weld; burnt cinder near center.
Rod B, middle of rod	1⅛	.8	.655	79, 359	53, 198	Dull fibrous.
Rod C, weld specimen	⅞	.515	.489	59, 265	53, 420	Nearly perfect weld.
Rod C, middle of rod	⅞	.515	.4	80, 005	54, 294	Dull fibrous.
Rod D, weld specimen	⅞	.514	.539	(*)	46, 896	Broke in weld; rusted in weld: bad weld.
Rod D, middle of rod	⅞	.514	.443	87, 952	59, 569	Dull fibrous.
Rod G, cut cold from end of rod	1¼	.8	.706	71, 525	55, 705	Dull fibrous.

*Specimen was enlarged, owing to wedging of parts at point of rupture.

A copy of the above record was sent to the contractors on the 18th of July, and they were informed that the iron would not answer the purpose for which it was intended; that it was inferior to the requirements of the contract, and would not be accepted.

On the 26th of July, 1872, some other rods, which had been received for further trial, were tested at the request of the contractors, with the following results:

	Diameter.	Breaking-weight.	Breaking-weight per square inch.	Remarks.
	Inches.	*Pounds.*	*Pounds.*	
Rod A	1¼	46, 740	38, 300	
Rod B	1⅛	26, 500	26, 500	One of the bent rods.
Rod C	⅞	15, 260	34, 700	
Rod C	⅞	17, 950	40, 800	
Rod C	⅞	20, 310	46, 100	
Rod C	⅞	18, 460	41, 900	Broke in weld.
Rod D	⅞	15, 000	25, 000	Broke in weld.
Rod D	⅞	28, 000	46, 600	Broke in eye.
Rod D	⅞	22, 100	36, 833	Broke in weld.
Rod D	⅞	18, 000	30, 000	Broke in shank.
Rod D	⅞	24, 600	41, 000	Broke in eye.
Rod A	1¼	51, 840	42, 400	Broke in weld.
Rod A	1¼	55, 000	(*)	

*But not broken.

A copy of the above record was sent to the contractors July 27th. The tensile strength of the iron and the welding of the rods were shown to be so unsatisfactory by the foregoing tests that tests for permanent set were not made. On the 29th of July a telegram was received from the contractors, requesting that the iron be tested for permanent set, and some bars were prepared for these tests as soon as possible, and the tests were completed on the 6th of August.

In the mean time the following letter was received from the contractors:

CHICAGO, ILLS., *July* 30, 1872.

Bvt. Lieut. Colonel D. W. FLAGLER,
Commanding Arsenal, Rock Island, Ills.:

DEAR SIR: Herewith we hand you the results of tests by American Bridge Company made yesterday at our request. The iron tested were the different sizes in full length and size, just as they would go in place in the roof; no selection from pile was made, but taken as it came to hand. The clerk neglected the record of the 1¼ inch iron of elongation at 15,000 and 20,000 pounds' test, there being no set. I explain the iron breaking near the weld from the change which takes place in the heating of the iron near the weld. At the time the weld was made the welds were perfect. The least strain that could be put on the ¾ rod with the testing machine was equal to 28,000 pounds per square inch.

When you were here you remarked "if it stood test for permanent set it would be satisfactory." Should the tests for permanent set Captain Butler is about to make show as favorable as those of the American Bridge Company, we presume the iron will pass notwithstanding falling a trifle short of full condition of strength. The tester said it was the best iron that had been in the machine for a long time, and that it was very rare to find iron to stand high breaking strains and high strains without taking permanent set, and that most charcoal irons would take permanent set at 12 to 16,000 lbs., though not breaking under 60,000 lbs. Trusting that all may end well, awaiting the results by Captain Butler of tests and your reply at early convenience, we are,

Very truly, yours,

N. S. BOUTON & CO.

Tests for permanent set made by American Bridge Company.

Diameter of rod.	Area.	Length.	Strain per square inch.	Elongation.	Set.
Inches.	*Sq. inches.*	*Feet.*	*Pounds.*	*Inches.*	*Inches.*
1¼	1, 227	8	15, 000	0	0
1¼	1, 227	8	20, 000	1/32	0
1¼	1, 227	8	25, 000	1/16	0
1¼	1, 227	8	30, 000	3/32	0
1¼	1, 227	8	35, 000	7/64	3/64
1¼	1, 227	8	54, 500	(*)	(*)
1⅛	0, 994	11	25, 000	3/32	1/32
1⅛	0, 994	9	39, 600	.....	2 3/64
1⅛	0, 994	.....	48, 000	(*)	(*)
1⅛	0, 601	7	20, 000	3/64	0
			25, 000	1/16	0
			30, 000	5/64	0
			35, 000	1/8	1/32
			40, 000	1 3/32	1 3/32
			57, 000	.....	3 5/64
			60, 000	5 1/4	(‡)
¾	0, 442	7	28, 000	3/32	0
¾	0, 442	7	34, 000	1/8	0
¾	.....	7	40, 000	3/32	1/32
¾	.....	7	50, 000	1 1/2	.....
¾	.....	6	73, 000	6 3/4	(‡)

* Broke near the weld; weld perfect.
† Pin for holding eye-bar 1¾ inches diameter.
‡ Broke near weld.

Respectfully submitted.

THE AM. BR. CO.
Per W. G. COOLIDGE.

On the 6th of August the tests for permanent set on the arsenal testing-machine having been completed, a record of the same was sent to the contractors with the following letter:

ROCK ISLAND ARSENAL, ILLS.,
August 6, 1872.

Messrs. N. S. BOUTON & Co.,
Chicago, Ills.:

GENTLEMEN: In reply to your letter of July 30th I have the honor to transmit herewith a report of tests for permanent set upon four specimens of girder rods, taken from the iron furnished by you under contract for one of the iron roof frames for shops at this arsenal. Except in the specimen from rod B, the iron has given satisfactory results in this respect.

Respecting the tensile strength of the iron, as shown in report of tests sent to you July 18, I have to state that although none of the specimens gave the strength required by the contract, the weld specimen failed badly, giving respectively only 62½, 75½, 78, and 89 per cent. of the strength required by the contract. I do not think it would be safe to put the iron in such condition in the roof, and I cannot consent to do so. The rods are liable to extraordinary strain in case of great storms, either of wind or snow. For an ordinary storm or fall of snow the strains will not exceed the limit for permanent set, but the additional strength is required to save the roof from falling during a tornado, even though girders should be stretched beyond the limit of permanent set. If, then, the welds are unreliable, we have no margin for safety left. I cannot remember to have told you anything from which you could infer that the test for tensile strength is not very important, for I deem it of the utmost importance. I could make more tests, but I should not think it necessary, and the time when a portion of the roof is required is very near. I see no other course but to make the welds over again. Lieutenant Butler will hand this letter to you and consult with you on the subject.

The required strength of the iron was fully stated, both in the advertisement inviting proposals and in the contract, and it would not be fair to take iron which does not fulfill requirements which may have prevented other parties bidding low enough to secure the contract.

Respectfully, your obedient servant,

D. W. FLAGLER,
Captain of Ordnance, Bvt. Lt. Col. U. S. A., Commanding.

Tests of iron rods for roof frames, Shop E, Rock Island arsenal. Specimen 10 *inches long from rod A.*

Original diameter 1¼ inches. Turned down to .8 inch.

Weight applied per square inch.	Extension per inch in length.	Restoration per inch in length.	Permanent set per inch in lengh.
9,947.3	.0021	.0021	.....
11,936	.0021	.0031	.....
13,926	.0066	.0066	.....
15,915	.0094	.0094	.....
17,905	.0068	.0094	.....
19,895	.0083	.0080	.0003
21,885	.0096	.0092	.0004
23,675	.0106	.0100	.0006
25,865	.0112	.0105	.0007
27,855	.0124	.0115	.0009

Broke at 56,699 pounds per square inch.

Specimen 10 *inches long from rod B.*

Original diameter 1¼ inches. Turned down to .8 inch.

Weight applied per square inch.	Extension per inch in length.	Restoration per inch in length.	Permanent set per inch in length.
9,947	.0048	.....	.....
11,938	.0045	.....	.....
13,926	.0048	.....	.....
15,915	.0065	.0059	.0006
17,905	.0072	.0064	.0008
19,895	.0082	.0071	.0011
21,005	.0083	.0072	.0011
23,875	.0093	.0082	.0011
25,865	.0102	.0086	.0016
27,855	.0122	.0100	.0022
29,845	.0135	.0091	.0044
31,838	.0192	.0102	.0090
38,825	.0372	.0096	.0286

Broke at 52,243 pounds per square inch.

Specimen 10 *inches long from rod C.*

Original diameter ¾ inch. Turned down to .551 inch.

Weight applied per square inch.	Extension per square inch in length.	Restoration per inch in length.	Permanent set per inch in length.
10,495	.0048	.0048	....
12,610	.0042	.0042	....
14,674	.0056	.0056	....
16,775	.0065	.0065	....
18,872	.0068	.0068	....
20,970	.0070	.0070	....
23,067	.0095	.0092	.0003
25,160	.0117	.0014	.0003
27,257	.0117	.0110	.0007
29,354	.0121	.0107	.0014
31,451	.0184	.0100	.0064
33,548	.0218	.0207	.0114

Broke at 35,569 pounds per square inch.

Specimen 10 *inches long from rod D.*

Original diameter ¾ inch. Turned down to .551 inch.

Weight applied per square inch.	Extension per inch in length.	Restoration per inch in length.	Permanent set per inch in length.
10,495	.0034	.0034	....
12,610	.0048	.0048	....
14,674	.0057	.0057	....
16,775	.0063	.0063	....
18,872	.0067	.0067	....
20,970	.0107	.0107	....
23,067	.0184	.0184	....
25,160	.0195	.0195	....
27,257	.0200	.0197	.0003
29,354	.0206	.0203	.0003
31,451	.0214	.0226	.0003
33,548	.0237	.0224	.0013
36,645	.0265	.0225	.0040

Broke at 39,557 pounds per square inch.

On the 6th of August, 1872, I directed Lieut. W. P. Butler, Ordnance Department, to proceed to the iron-works of N. S. Bouton & Co., Chicago, Ill., and inspect such parts of the roof-frame of Shop E as were ready for shipment, and also to make arrangements in accordance with verbal

instructions given him respecting the making over of certain parts rejected.

The following is copied from Lieutenant Butler's memoranda of inspections and tests made by him:

This iron was rejected by Colonel Flagler on account of its low average tenacity, the defective welds shown by the tests, and the general appearance of fractures.

The contractors had corresponding rods tested in the machine of the American Bridge Company in Chicago for tenacity and permanent set. These tests gave much better results than those made at Rock Island arsenal.

The contractors therefore objected to the rejection of the iron, claiming that the rods themselves should be put in the machine instead of specimens cut from the rods; that turning off the outer skin of the iron would lower its tenacity per square inch of section.

On examination, the machine of the American Bridge Company was found to be a heavy hydraulic cylinder, using glycerine instead of water. The piston is 17 in. diameter. The gauge is the ordinary mercury gauge, very carelessly used. No allowance made for friction. Its results should not, therefore, shake confidence in the machine at Rock Island arsenal. All measurements were made roughly, by an ordinary two-foot rule, in the tests of the American Bridge Company, while those at the arsenal were to within .0001 inch. As some of the iron tested had been of good quality, Colonel Flagler consented to allow N. S. Bouton & Co. to inspect the rods then furnished and to reject all which they thought were inferior to the rods required; from the remaining rods Lieutenant Butler selected 20, which were brought to Rock Island arsenal for testing. The machine was then so arranged that the rods themselves, 9 feet in length, were tested with the results shown in the following tables. The necessary attachment to the machine was a crow-bar, suspended some distance below the floors and braced back against the bed of the machine. Suitable attachments were made at the cross-beams and the large lever of the machine for holding the closely-fitting bolts, passing through the eyes of the rod. This arrangement answered the purpose, but there was not enough motion in the lever to break a rod at one pull.

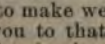
Report of tests of iron rods for roof-frame of Shop E; all the rods nine (9) *feet in length.*

Diameter.	Breaking-weight.	Breaking-weight per square inch.	Remarks.
Inches.	*Pounds.*	*Pounds.*	
1¼	46, 740	38, 600	
1¼	26, 500	26, 500	
	15, 260	34, 700	
	17, 950	40, 800	
	20, 310	46, 100	
	18, 460	41, 900	Broke in weld.
	15, 000	25, 000	Broke in weld.
	28, 000	46, 600	Broke in end of eye.
	22, 100	36, 833	Broke in weld.
	18, 000	30, 000	Broke in shank.
	24, 600	41, 000	Broke in eye.
1¼	51, 840	42, 400	Broke in weld.
1¼	----------	----------	Not broken at 55,000 pounds.

On the 18th of August, 1872, I wrote to Messrs. N. S. Bouton & Co., Chicago, as follows:

I have the honor to inclose herewith a record of the tests made at this arsenal of iron rods furnished by you for the iron roof-frame of Shop E. I have also directed that one fragment of each of the broken rods be sent to you. You will observe, from the record of the tests, and from the appearance of the fractures, that the iron is poor and unreliable. It will not be accepted.

On September 4, 1872, Messrs. N. S. Bouton & Co. replied as follows:

The iron, to replace that for the roof rejected, is now being made by Carnegie, Kloman & Co., of Pittsburg, Penn., and we have directed them to forward you at once bars of each size for testing. If desired to make welds with same iron as used in forming the eyes, we will, on hearing from you to that effect, forward you a bar. Please test on full size; also, by turning down, by simply cutting a groove, thus  . Will you name a price for welding the ends and boring the same, at which you would have the work done there, we furnishing ends and rods?

Under date of September 5, 1872, I answered the foregoing letter as follows:

In reply to your letter of the 4th instant, I have to state that I will test any pieces of roof-iron sent by Messrs. Carnegie, Kloman & Co. as soon as received, and will report results. I have to request that you will use all possible dispatch in furnishing the roof, as I wish to commence putting it up by the last of this month. You must use your own judgment in selecting iron to make welds. If you will send a specimen of the iron you design using, I will make a test of it. I cannot weld the ends of the rods at this arsenal, as we have not shop-room to handle the rods.

On September 23, 1872, I wrote again to Messrs. N. S. Bouton & Co. as follows:

A part of the walls of Shop E are now ready for the roof-frame. It is very important that I should have the iron here, in order to cover in the building during this year. No specimen of iron has been received. Please inform me, at your earliest convenience, what steps you are taking to complete the work.

Messrs. N. S. Bouton & Co. telegraphed, under date of September 24, as follows:

Test-iron was shipped on 14th instant. A large portion of the rafters and purlins are ready for shipment, but are waiting for new iron to take place of that portion of trusses condemned.

Some samples of iron were received in September and October, which were tested and found to be unsuitable. In November some samples were received which were satisfactory, but it was then too late in the season to put up the roof that fall, and the following letter was sent to the contractors:

ROCK ISLAND ARSENAL,
November 13, 1872.

Messrs. N. S. BOUTON & Co.,
Chicago, Ills.:

GENTLEMEN: I have the honor to acknowledge the receipt of your letter of the 12th inst., and in reply to state that the season is now so far advanced that I will not put up the roof of Shop E till spring, and that you can therefore have the whole winter in which to construct the roof and procure a suitable iron.

The delay in the constructon of the roof has interfered seriously with my plans; but I cannot, consistently, incur the danger and expense of putting it up during the bad weather of winter.

I hope the roof will be ready for delivery as soon as April 1, 1873.

Very respectfully, your obedient servant,

D. W. FLAGLER,
Brt. Lieut. Colonel, Comdg.

The roof-frame was all delivered during the following winter and spring. (See annual reports of principal operations for the fiscal years ending June 30, 1873 and 1874.)

BOILER-HOUSE, CHIMNEY, ENGINE-ROOM, AND SHOP-FIXTURES FOR SHOP C, AND FOUNDERY AND FORGING-SHOP AND FIXTURES IN SHOP E.

Plans for these were made in the summer and fall of 1871, and were approved by the Chief of Ordnance during his visit at the arsenal in the fall of that year. The site and plans of the boiler-house and chimney are shown on the map on Plate VI. The engine-room, 20 by 90 feet, is on the first floor of the shop in the front part of the building, between the two wings. The boiler-house and chimney were begun in the fall of 1871, but the setting of the boilers, putting up the engine and shop-fixtures, and other work of fitting up the shop for use, was not completed till August, 1873. A full report and description of all this work is given in the annual reports for 1872, 1873, and 1874. (See Appen-

dixes A, B, and C to this chapter.) Copies of all the drawings referred to are on file at the Ordnance Office and at the arsenal. In devising and carrying out the plans for this work, much credit is due to Mr. James Stevenson, master-machinist at the arsenal. The shop-fixtures were all made at the arsenal. The patterns, drawings, and full bills of materials and details of cost are kept at the arsenal, and are available for future work of the same kind. The experience gained in running the shops nearly four years is such as to show that these plans would not require material change and would be followed closely in fitting up other shops, thereby permitting the use of the drawings, patterns, and information on hand.

I believe, however, that experience has shown that for the shops in the arsenal row it would be better to place the engine-rooms on the basement floors instead of on the first floors, and to occupy for this purpose the space corresponding to that directly under the engine-room in Shop C. This arrangement would save some valuable shop-room on the first floor, and would be preferable in other respects.

The location of the boiler-house has, I believe, proved the best that could be selected.

The engine was first started and the use of the arsenal shops begun on the 16th of August, 1873. It was reported to the Chief of Ordnance in the following letter:

ROCK ISLAND ARSENAL, ILLINOIS.
August 19, 1873.

The CHIEF OF ORDNANCE,
U. S. Army, Washington, D. C.:

SIR: I have the honor to report that the work on the battery of boilers and the new engine and shop-fixtures for Shop C has so far advanced that fires were placed under the boilers, and the machinery in the new machine-shop started on Saturday last. The results were entirely satisfactory. This is the first use of any of the permanent machinery of Rock Island arsenal.

Very respectfully, your obedient servant,

D. W. FLAGLER,
Captain of Ordnance, Bvt. Lieut. Colonel U. S. Army, Commanding.

THE MOLINE BRIDGE.

This is one of the arsenal bridges across the south channel between the island and the Illinois shore, and connects the island at its eastern or upper end with the city of Moline. (See map on Plate VI.) By reference to the report of the Rock Island board of commissioners in the third chapter of this book, it will be seen that the town of Moline was the owner in fee of a certain bridge and roadway connecting the head of the island of Rock Island with Mill street in the town of Moline. The award of the commission in this case was that the United States should pay to the town of Moline the sum of $2,000 for the bridge and roadway, on condition that the United States should have the free use of the streets of Moline connecting with the bridge, the right to construct for the use of the Government another bridge connecting the island of Rock Island with the town of Moline at any point the United States might select, and the right to construct the necessary approaches to said bridge in the town of Moline. In accordance with the requirements of the act of Congress, April 19, 1864, the award was confirmed by the United States district court for the northern district of Illinois, Hon. Thomas Drummond, judge; and the board of trustees of Moline passed a resolution waiving an appeal, and authorized Mr. Jonathan Huntoon, of Moline, to receive and receipt for the sum awarded. The sum awarded, $2,000, and $40 interest, was paid May 29, 1867. The

Moline approach to the bridge is on the site of the old bridge and roadway, and by the action of the court, in conformity with the requirements of the acts of Congress in the case, the United States acquired its title to the land occupied by the approach. Moreover, as the approach is in the part of the river occupied by the water-power pool, and none of it on the shore side of the shore-line, it is believed that the United States also acquired a title to the land occupied by it in acquiring a title to the water-power by award of the commission.

In giving an account of the construction of the upper dam wall of the water-power in 1869, it was stated that advantage was taken of the opportunity, while the coffer-dams were in and the bed of the river or pool bared for work on the water-power, to put in the piers and abutments for the bridge at that time. It was estimated by General Rodman that the cost of doing the work at that time would be about $8,350 less than if it were postponed till some future time when special coffers for the work would have to be put in. Also the necessary derricks and appliances, which had been used in setting stone on the water-power wall, were on hand at the point required, and the whole bed of the river was bare for convenient work. The piers and abutments were put in in December, 1869, and January, February, March, June, and July, 1870.

In January the coffers gave way and the site of the piers was flooded with water, and work was suspended about five weeks. In February the ice formed on the river strong enough to bear the derricks, and work was resumed. The masonry was nearly completed in March. The work was under the immediate charge of Capt. Morris Schaff, Ordnance Department, one of the assistant officers at the arsenal. The stone was furnished by Messrs. Sanger & Steel, from their quarries near Joliet, Ill. There are four piers and two abutments spaced for five equal spans of 142 feet and 3 inches each, making the total length of the bridge 711 feet and 3 inches. The total masonry in the piers and abutments is 1,140 cubic yards, and its total cost was $27,500. The dimensions of the piers are as follows: At the bottom, 35 feet long and 8 feet wide; at the top, 26 feet long and 6 feet wide; average height, 20 feet. All the piers are on the solid bed-rock of the river. The superstructure was not erected till the spring of 1873.

There was a good deal of correspondence between General Rodman and the Chief of Ordnance respecting the construction of the piers and the bridge which is not now of material importance, except so much of it as finally procured the construction of the piers and the postponement of the erection of the superstructure. On the 14th of April, 1869, General Rodman, while in Washington, addressed a letter to the Chief of Ordnance stating that in his last annual estimate for funds for the Rock Island arsenal he had included an estimate of $125,000 for the construction of a bridge from the upper end of the island to the town of Moline; that this money, if appropriated by Congress, would not be available for use until after July 1, 1870; that in carrying out agreements with the water-power company made by the Secretary of War he would have the river-bed bared for work at the site of the bridge in the spring of 1869; and, as it would be very economical to construct the bridge at that time, he asked that it might be done out of appropriations for the arsenal then available, that is, out of appropriations for the year ending June 30, 1869. In a reply, dated April 14, 1869, the Chief of Ordnance granted the authority requested. Work on the bridge was not begun, however, in the fiscal year ending June 30, 1869.

The appropriations by Congress for the ensuing year appropriated a

lump sum for the Rock Island arsenal, and did not specify the objects to which it should be applied. General Rodman then wrote to the Chief of Ordnance, August 4, 1869, again asking that $125,000 of the new appropriation, that is, of the appropriation for the year ending June 30, 1870, might be used in building the bridge. The reply of the Chief of Ordnance, dated August 11, 1869, was as follows:

I was not aware that the building of the bridge to connect Rock Island with the town of Moline had been submitted to and authorized by the Secretary of War; but it is thought that the construction of this bridge may be deferred for the present, and the funds required for its construction applied to other objects of more immediate importance with benefit to the service; for which reason the construction of this bridge out of the appropriation already made for your arsenal, is not approved by this bureau.

General Rodman wrote again, on the 14th of August, giving reasons why the bridge should be built that year, and recommending it; but the recommendation was not approved. On the 29th of November, 1869, Hon. J. B. Hawley, at that time member of Congress from the district of Illinois in which Moline is situated, wrote to General Rodman urging the construction of the bridge, and asked how much the United States would save by building the bridge at that time, while the river-bed was bare and the expense of coffering could be avoided. General Rodman's reply to this letter was as follows:

ROCK ISLAND ARSENAL, *December* 5, 1869.

Hon. J. B. HAWLEY,
Washington City:

SIR: Yours of the 29th ult. relative to bridge at Moline is received. In reply I have to state that the cost of constructing three piers and two abutments, *now*, while the bottom of the river is bare, up to say one foot above low water, is estimated at eight thousand seven hundred ($8,700) dollars, and to construct these piers and abutments complete now, while the bottom is bare, sixteen thousand seven hundred ($16,700) dollars, and to construct these piers and abutments complete after the dam shall have been completed and the water let into the pool, the cost is estimated at twenty-five thousand and fifty ($25,050) dollars, making a saving of eight thousand three hundred and fifty dollars by doing the work now instead of after the water shall have been let into the pool. Two weeks of working weather will complete the dam-wall, and we shall have derricks thrown out and idle before the end of this week, which should be put to work on bridge-piers at once if they are to be built this winter. And four weeks of good working weather will build the bridge-piers if we are not detained for want of stone. If the piers are to be built this winter, we should know it at the earliest possible moment.

T. J. RODMAN,
Lieut. Col. of Ordnance.

On the 7th of December General Rodman wrote to the Chief of Ordnance, inclosing a copy of the above letter to Mr. Hawley, and again urged reasons for putting in the piers and abutments for the bridge at that time, and proposed that the superstructure be left to be added at some future time. The reply of the Chief of Ordnance, dated December 9th, authorized the building of the piers to one foot above low-water mark, and, in some subsequent correspondence, authorized the completion of the piers and the construction of four piers instead of three. I have heard it stated that, before his death, General Rodman changed his views respecting the bridge, and thought its construction should be deferred until other more important arsenal constructions were completed. This does not appear probable, for in an annual estimate made by him in the summer of 1870 there is an item of $100,000 for building the bridge. No appropriation for the work, however, was made at that time, nor for some years afterward.

I was placed in command of the arsenal in June, 1871, but the foregoing correspondence was not called to my attention at that time nor

until after the bridge was completed, in 1873. The importance of the bridge to the interests of the arsenal was frequently represented by citizens of Moline, and I was asked to include it in annual estimates, but did not do so. It did not appear to be immediately necessary, and it seemed that other more important work at the arsenal was required first, and that the construction of the bridge could be deferred for a time. The citizens of Moline were very solicitous about it, however, and through the influence of Mr. Hawley finally obtained a special appropriation for the bridge. In January, 1872, I received a letter from the Chief of Ordnance asking my views in the matter, and in reply I gave the above reasons for not having included an item for the bridge in annual estimates, but stated that the bridge would be a great convenience, and was so important that it would have to be built some time; that if an appropriation for it could be obtained without prejudicing other important work, it would be very desirable. At about this time the following paper was sent to the Chief of Ordnance:

MOLINE, ILLINOIS, *December 26th*, 1871.

Hon. JOHN B. HAWLEY:

DEAR SIR: We are advised that the Secretary of War and the officers of the War Department are opposed to the completion of the Government bridge between the town of Moline and the island of Rock Island, because of the fears entertained by them respectively that the citizens of Moline and vicinity will desire to use the bridge and island for the purpose of teaming with loaded wagons between Moline and the cities of Rock Island and Davenport; and the old landing formerly used by the citizens of Moline, on the north side of the island, and the further fear that the construction of the bridge will ultimate in the establishment of a horse-railway across or down the island. In view of the facts that such fears have been expressed, and because we, as citizens of Moline, believe them to be entirely unfounded, we desire to say in this ormal manner that we do not desire or expect, and will not ask, to use said bridge or any of the road upon the island leading therefrom for any of the purposes stated. We desire to say, further, that in the expression of these views we believe we but speak the sentiment of this entire community. We most earnestly desire the completion of the bridge at an early day, and think, in view of the fact that it has been repeatedly promised by the Government, that two Secretaries of War have ordered its construction, and the further fact that the piers have been put in, as also its necessity for the convenience of the Government and the people, that we may reasonably ask for its prompt completion.

Very respectfully, yours,

J. T. BROWNING.
JONATHAN HUNTOON.
WM. A. NOURSE.
W. J. ENTRIKIN.
S. W. WHEELOCK & CO.
JAMES SHAW.
BARNARD & LEAS.
WILLIAMS, WHITE & CO.
REID & STONE.
J. M. CHRISTY.
W. G. MORRIS.
DIMOCK, GOULD & CO.
H. O. SLEIGHT.
A. M. GUILD.
VICTOR SCALE CO.
J. S. RICHARDS.
HENRY E. BARNES.
FIRST, ROSENFIELD & CO.
MOLINE PLOW CO.
J. S. GILMORE,
Cashier 1st Natl. Bank.
C. W. LOBDELL,
Cashier Manufacturers' Bank.
H. F. SICKLES.
H. G. NOURSE.
J. M. GOULD.
GEO. W. VINTON.
A. S. WRIGHT.
DEERE & CO.
J. S. KEATOR.
C. R. AINSWORTH.
ALEX. F. SWANDER.
MOLINE WATER-POWER CO.,
By J. M. GOULD, *Secy.*
WRIGHT, HILLBROUSE & CO.
MOLINE WOOLEN CO.
WM. KERNS.
D. L. WHEELOCK.
HENRY KLAHN.
Trustees of the Town of Moline.

I, O. K. Ferguson, clerk of the board of trustees of the town of Moline, do certify that the foregoing named persons compose the entire board of trustees of said town.

Witness my hand and official seal.

O. K. FERGUSON, *Clerk.*

In February the Secretary of War and Chief of Ordnance made the following application for an appropriation:

WAR DEPARTMENT, *February* 13, 1872.

The Secretary of War has the honor to send to the House of Representatives a communication from the Chief of Ordnance, recommending an appropriation of $100,000 for the completion of the wagon-road bridge connecting Moline with Rock Island, Illinois.

WM. W. BELKNAP,
Secretary of War.

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, February 12, 1872.

SIR: On the 14th April, 1869, authority was given by General Schofield, Secretary of War, for the construction of a wagon-road bridge, connecting the town of Moline, Illinois, with the upper end of the island of Rock Island. On the 9th December, 1869, upon the recommendation of General Rodman, commanding the arsenal, the piers and abutments of the bridge were, under your authority, ordered to be built. No appropriation for building the superstructure of the bridge has been asked for, and the work is in the same condition it was left upon the completion of the piers. Funds have not been heretofore requested to prosecute the work to final completion, because other objects at Rock Island arsenal, of more immediate importance, demanded earlier attention, and I felt that this project might be deferred for a time without serious inconvenience to the Department. It was for this reason that the Department refused the application of the commanding officer of the arsenal to permit the bridge to be built from appropriations that were under its control. I am entirely of the opinion that the bridge will be of great public convenience, and inure to the benefit of the public service, and do recommend that $100,000 be appropriated for its completion, this being the sum estimated. It may be well to state that the town of Moline has pledged itself not to ask to be allowed to use the road between the bridge and the lower part of the island as a public highway.

Very respectfully, your obedient servant,

A. B. DYER,
Chief of Ordnance, United States Army.

Mainly through the influence of Mr. Hawley, the following appropriation act was passed:

AN ACT making appropriations for sundry civil expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and seventy-three, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, for the objects hereinfter expressed, for the fiscal year ending June thirtieth, eighteen hundred and seventy-three, viz:

ARMORIES AND ARSENALS.

Rock Island armory and arsenal, Rock Island, Illinois.

For completion of the wagon-road bridge connecting Moline with Rock Island, one hundred thousand dollars.

In August, an advertisement was published inviting proposals to erect the superstructure, and a contract for the work was awarded to Messrs. Clarke, Reeves & Co., of Philadelphia, in the following October; the iron-work to be manufactured by the Phœnix Iron Company, of Phœnixville, Pa. The contract-price for the superstructure was $60,820, but some additional expense was afterward incurred on account of a double floor and some other changes and additions. The iron railings were furnished by Robert Wood & Co., of Philadelphia. The cast-iron ornamental portals, lamp-posts, and some other parts were manufactured in the arsenal-shops. The total cost of the superstructure, approaches, retaining-walls, riprapping, painting, engineering, inspecting, and testing was $93,539.32. This, added to the cost of the piers and abutments, makes the total cost of the bridge $121,118.11. It is believed that the quality of the iron in this bridge is much better than that in any of the

other arsenal-bridges, and the strain that would be produced by the maximum load that could be put on the bridge is only one-seventh of the total strength of the iron. There was a good deal of correspondence with the contractors respecting the quality of the iron and details of construction, which is of no special importance now. The bridge was completed and made ready for use in May, 1873. It is 711 feet 3 inches long, divided into five equal spans, 20 feet wide in the clear between the wheel-guards, and the sidewalks are 5 feet wide in the clear between the protecting wood-work over the bottom chords and the railings. At its commencement this work was placed under the immediate charge of Lieut. W. P. Butler, Ordnance Department, one of the assistants at the arsenal, and this officer calculated the bridge company's strain-sheets. Lieutenant Butler was relieved from duty at the arsenal in December, 1872, and I attended in person to the construction and erection of the bridge and tests of the iron. A description of the bridge and an account of nearly all that was interesting in its construction is contained in the following extract from my annual report of principal operations at the arsenal for the year ending June 30, 1873:

The new iron bridge from the east end of the island to the city of Moline, generally known as the Moline bridge, has been completed, and was opened for travel about May 29th. I inclose herewith drawings of the bridge, and a strain-sheet for one span. The spans are all precisely alike. I believe the bridge fulfills all requirements for strength, durability, and convenience. It is a very handsome structure. As regards strength, I have to report as follows:

In determining dimensions and strength of parts, calculations were made for a moving load of 2,500 pounds per lineal foot. The minimum limit of tensile strength was placed at 55,000 pounds per square inch of cross-section, and the minimum limit of elasticity at 20,000 pounds, and with both the moving and dead load, no iron under tensile strain was to be strained more than 9,000 pounds per square inch. (The limit of tensile strength was placed at 55,000, because that was the limit obtained in the Rock Island bridge, tests for which were made at this arsenal, although the contract was for 60,000.) The Phœnix Iron Company obtained the contract for the iron, and one of their proposals was for iron with tensile strength of 60,000 pounds; permanent set not to take place under 25,000 pounds; and this proposal was accepted. The tests gave near 63,000 pounds of tensile strength, and in no case a permanent set under 25,000 pounds. Tests for the latter were made upon completed bars, ready for the bridge. The dimensions of parts were then made as required for a strength of 55,000 pounds. The dead-load, therefore, remaining constant, the increase of strength is all available for a moving load, and placing the latter at 2,500 pounds per lineal foot, the working strain falls considerably below $\frac{1}{7}$ of the total strength. Iron bridges are generally constructed for a working strain of $\frac{1}{4}$ of total strength. This makes the strength of the bridge much greater than is generally required in the best iron bridges. Moreover, it is almost impossible that so great a moving load as 2,500 pounds per lineal foot will ever be placed on the bridge. If wagons are packed two abreast, the weight of wagon and load placed at 6,000 pounds, and of two horses and driver at 2,700 pounds, the load will be less than 1,000 pounds per foot. If the weight of men be placed at 200 pounds each, and they be closely packed, each occupying two feet square, both on roadway and sidewalks, the load will be 1,500 pounds per foot. The tests of the iron having been satisfactory, and the difficulty of putting a sufficient load on the bridge being considerable, I did not make a full test of the span. While building the approaches, I packed one span with wagons, three abreast, each wagon loaded with about 4,000 pounds of earth and rock, without perceptible depression of the span.

The truss is the Whipple, with diagonal main posts, flat bar stays, Phœnix patent column, top chord, and posts, and pin connections. The floor-beams are heavy 15″ iron I-beams, with wooden joists, and the deck of the roadway two thicknesses of plank. The lower thickness is of 2″ pine plank laid laterally, and the upper oak plank 3″ × 6″ laid longitudinally. The roadway is 20 feet wide in the clear. There are two footwalks outside the chords, each five feet wide in the clear, with wrought-iron handrails.

The island approach is completed. It has a grade of one upon 38, and is piked with rock 12″ thick, and covered with 5″ of gravel. For the Moline approach, there was required a heavy fill. The abutment is placed in the river 80 feet from the shore. The grade of this approach has a rise of 3′ 8″ in 80 feet.

The hand-rail of the bridge continues down the slope crests of the approach, and on each side are stone footwalks 5 feet wide. The approach is also piked and graveled.

The present Chief of Ordnance, Brig. Gen. S. V. Benét, made his first visit of inspection at the arsenal in May, 1875. He remained six days at the arsenal and made a full inspection of all the work of construction that had been performed, of that in progress, and methods employed for carrying it on, and of plans for future work and interests connected therewith.

During the period of time embraced in this chapter the business at the arsenal, connected with the care and preparation of ordnance-stores and the supply of the Army, has greatly increased. The Chief of Ordnance, during his visit at the arsenal, made a special examination of the facilities for commencing at the arsenal at once the manufacture of stores for the Army, the sources from which the materials to be consumed in such manufactures could be procured with the greatest economy, and the cost of such work at this arsenal, compared with the cost of the same at the eastern arsenals. In accordance with his instructions the work of manufacturing was begun in the month of July following. An account of this is given in my annual report for the year ending June 30, 1876. (See Appendix E to this chapter.)

In September, 1873, the ordnance depot at Omaha, Nebr., and in May, 1874, the arsenal at Leavenworth, Kans., were broken up. Since the latter date, nearly all the ordnance-stores required for the Army in the Indian country have been supplied from this arsenal.

Since 1871 the following arsenals have been broken up, or their use as arsenals discontinued, and the bulk of the property on hand has been transferred to this arsenal and overhauled, broken up, stored, or made fit for issue to the Army, viz:

Mount Vernon Arsenal, Alabama, in 1872.
Baton Rouge Arsenal, Louisiana, in 1871.
Leavenworth Arsenal, Kansas, in 1874.
Detroit Arsenal, Michigan, in 1875.
Columbus Arsenal, Ohio, in 1875.

During my command, since June, 1871, the following mentioned officers have been stationed at the arsenal as assistants:

Capt. Morris Schaff, from November 10, 1868, to December 31, 1871, at which date he resigned.
Lieut. M. L. Poland, from December 23, 1868, to August 5, 1871.
Lieut. E. M. Wright, from June 13, 1871, to November 10, 1875.
Lieut. W. P. Butler, from October, 1866, to July, 1873; resigned July 12, 1873.
Lieut. Charles Shaler, from July, 1870, to August, 1874.
Capt. J. P. Farley, from September 17, 1871, to June 29, 1874.
Lieut. Cullen Bryant, from May 20, 1872, to June 25, 1872.
Lieut. Issac W. Maclay. This officer was assigned to duty at this arsenal, but was here only one day, (October 18, 1873;) resigned November 15, 1873.
Lieut. W. S. Beebe, from September 24, 1873, to November 1, 1873; resigned, to take effect January 1, 1874.
Capt. W. A. Marye, from June 15, 1874, to June 12, 1876.
Lieut. A. L. Varney, from May 29, 1874, to November 28, 1874.
Lieut. W. S. Starring, from November 14, 1874, to July 19, 1876.
Lieut. M. W. Lyon, from December 15, 1874, to November 10, 1875.
Lieut. J. C. Ayres, from November 14, 1874.
Lieut. D. M. Taylor, from January 14, 1876.
Capt. J. C. Clifford, from June 12, 1876.
Lieut. James Rockwell, from November 21, 1876.
Capt. A. S. M. Morgan, O. S. K., from August 9, 1875.

During my absences from the arsenal the following officers have been temporarily in command:

Lieut. M. L. Poland, from June 9 to July 13, 1871.
Capt. J. P. Farley, from March 11 to April 12, 1872.
Capt. J. P. Farley, from January 13 to March 28, 1873.
Capt. J. P. Farley, from September 26 to October 16, 1873.
Capt. W. A. Marye, from August 18 to September 2, 1875.
Capt. W. A. Marye, from February 8 to March 4, 1876.
Capt. J. C. Clifford, from October 30 to December 1, 1876.

In 1873, an act of Congress was passed looking to the establishment of a military prison at the arsenal. As the history of this matter does not belong to the history of the construction of the arsenal and work connected therewith, to which this chapter is devoted, the act referred to and the subsequent correspondence and action, which led to the establishment of the prison at Fort Leavenworth, Kans., are copied in an appendix. (See Appendix G to this chapter.)

There is not much else connected with the history of the construction of the arsenal during the period of time under consideration that is not included in the annual reports for the different years.

In all the building operations embraced in this chapter, difficulties and delays were encountered in procuring iron and stone of suitable quality and in sufficient quantities. A sample of the difficulties met with in procuring iron was given in the history of the purchase of the roof-frame for Shop E. This led to the subsequent manufacture of the roof-frames for Shops D, A, and F at the arsenal, the new Shops E and C affording ample facilities for doing the work. So long as the frames were manufactured by outside parties under contract, only a few were competent to do the work, and the number of bidders for the work was limited to these few. When the frames were manufactured in the arsenal-shops, all parties competent to furnish the iron became competent to bid, and it is thought that a considerable saving in the cost of the iron was effected. Besides this, a very considerable saving in the cost of manufacture was effected, as is shown in Appendix E to this chapter.

The difficulty of procuring iron of suitable quality under the laws and regulations governing purchases and appropriations, also led to a plan, as shown in the following correspondence, for the manufacture of the higher grade of iron required for roof-frames and other purposes, from old scrap on hand, as soon as the armory rolling-mill (Shop F) should be so far completed as to permit it.

On the 21st of November, 1874, an offer was received to purchase about 120,000 pounds of wrought-iron scrap, at the price of $20.50 per ton of 2,000 pounds. I referred this letter to the Chief of Ordnance, with the following indorsement:

ROCK ISLAND ARSENAL, *November* 23, 1874.

Respectfully forwarded to the Chief of Ordnance, U. S. A.

The within-mentioned stores have been offered at public sale. I do not think the prices offered are sufficient.

I believe that all wrought-iron scrap, and particularly gun-carriage-iron scrap, should be retained at this post for conversion into a high grade of bar-iron for the use of the Ordnance Department when the rolling-mill shall have been completed.

This letter was returned to Major Flagler with the following indorsement:

ORDNANCE OFFICE, *Nov.* 27, 1874.

Respectfully returned to the commanding officer of Rock Island arsenal, whose views, as contained in first indorsement, are concurred in.

S. V. BENÉT,
Brigadier-General, Chief of Ordnance.

On the 3d of March, 1875, I indorsed a similar proposition to purchase about 288,000 pounds of obsolete and unserviceable horseshoes on hand at the arsenal, as follows:

I am firmly of the opinion that these shoes should be converted into wrought-iron scrap; that they should be retained at this arsenal, and that when the fixtures are put into the new rolling-mill a heating or scrap-furnace and train of "merchants' rolls" (or rolls containing the forms for iron most used by the Ordnance Department) should be added thereto, and that when required this iron should be worked over. It is not impossible that some of this iron may furnish stock good enough for the manufacture of gun-barrel blooms. It would certainly, when worked over, furnish the best iron required for ordnance purposes, and an iron the qualities of which would be fully understood, known, and assured.

The cost of working over would be one cent per lb., and would furnish an iron averaging in value 6 cents at ordinary prices. This lot of iron alone would pay about twice the cost of the plant required for working over the iron. With this end in view I am carefully preserving and storing all wrought-iron scrap that accumulates at this arsenal.

The horseshoes are now securely stored in the basement of one of the new shops, and additional storage-room of the same kind is almost unlimited. Besides the saving to the Government calculated herein in working over scrap, it is fair to take into account a further saving to ordnance appropriations, equal to the amount the iron would be sold for; for if the iron is sold it results in no benefit to these appropriations.

On the 8th of March, 1875, the Chief of Ordnance returned the foregoing-mentioned papers, as follows:

ORDNANCE OFFICE, *March* 8, 1875.

Respectfully returned to the commanding officer of Rock Island arsenal, whose views expressed in 2d indorsement are approved. The horseshoes referred to will be dropped from the returns and taken up as scrap.

S. V. BENÉT,
Brig. General, Chief of Ordnance.

It is believed that the rolling-mill and machinery for this work will be in condition to do this work before the roof of the next shop to be completed (Shop G) will be required. A sample of the difficulties met with in procuring sufficient supplies of stone, under the laws and regulations governing purchases, appropriations, and expenditures, was shown in the history of Store-house A and Shops B and C. Through changes in methods of purchase, these difficulties have been much less in subsequent years, and nearly all the stone required for the last two shops built, A and F, was delivered promptly, as required.

The most fruitful source of opposition to a proper and economical management of the work of building the arsenal, and the one which has been most pregnant with loss to the United States, has been the following section of an act of Congress, approved July 12, 1870, which provides:

That all balances of appropriations contained in the annual appropriation bills and made specifically for the service of any fiscal year, and remaining unexpended at the expiration of such fiscal year, shall only be applied to the payment of expenses properly incurred during that year, or to the fulfillment of contracts properly made within that year, and such balances not needed for the said purposes shall be carried to the surplus fund: *Provided*, That this section shall not apply to appropriations known as permanent or indefinite appropriations.

It is not supposed that this law was framed for or intended to apply to other appropriations than those the necessity for which should expire at the end of the year, such as pay of the Army, &c. It was found, however, that it applied to building operations at this arsenal, and its effect was, and has been, simply to compel the completion within the year of building operations, which, in the interest of economy and good work, should be extended through several years. This should be evident, without explanation, to an architect, and, with a little consideration, to any thinking mind.

Under the above and other laws, appropriations for the arsenal are not available till after July 1, and the time for using them expires on the 30th of the following June. After the 1st of July, the necessary advertising, execution of contracts and their approval, postpones the time of the first delivery of materials till September, and often till late in September.

The walls of the buildings are of stone, and the construction of the buildings involves as many of the difficulties and delays due to architecture and architectural engineering as are common to important Government buildings.

On account of the climate, the season for out-door and masonry work closes generally about the last of October, and does not recommence till after the middle of April. When a building has to be *finished* in the year, it must be covered in before winter in order that inside-work may go on *during* the winter. A consideration of the foregoing will show what obstructions this law has opposed to an economical management of the work since 1870. The difficulties and losses growing out of it were carefully set forth year after year in my annual reports, and some action to secure relief urged. (See Appendixes B and C to this chapter.)

Section 5 of an act of Congress approved June 20, 1874, gave relief in the case of appropriations for fortifications, light-houses, river and harbor improvements, and public buildings, but, as it appears, not to building operations at this arsenal.

The following correspondence and papers give an account of some efforts made to obtain relief from the operation of the law, in addition to what was stated and urged in the annual reports referred to above.

Sec. 5 of an act of Congress approved June 20, 1874, requires:

> That from and after the first day of July, eighteen hundred and seventy-four, and of each year thereafter, the Secretary of the Treasury shall cause all unexpended balances of appropriations which shall have remained upon the books of the Treasury for two fiscal years to be carried to the surplus fund and covered into the Treasury: *Provided*, That this provision shall not apply to permanent specific appropriations, appropriations for rivers and harbors, light-houses, fortifications, public buildings, or the pay of the Navy and Marine Corps; but the appropriations named in this proviso shall continue available until otherwise ordered by Congress. * * *

On the 6th of January, 1875, I wrote to the Chief of Ordnance, as follows:

> I have the honor to ask your attention to section 5 of an act of Congress approved June 20, 1874, which provides that appropriations for rivers and harbors, light-houses, fortifications, and *public buildings* shall continue available until otherwise ordered by Congress, and respectfully request that I may be informed whether the proviso therein for public buildings was intended, or may be construed, to include moneys appropriated for the erection of public buildings at this arsenal.

This letter was returned with the following indorsement:

> ORDNANCE OFFICE, *January* 12, 1875.
>
> Respectfully returned to the commanding officer of Rock Island arsenal.
>
> The 5th section of act approved June 20, 1874, embraces all public buildings—Rock Island arsenal included—but it does not permit the use of the money appropriated for any year after the expiration of said year, except in fulfillment of contracts made as provided in 5th section of act approved July 12, 1870.
>
> S. V. BENÉT,
> *Brigadier-General, Chief of Ordnance.*

This was returned to the Chief of Ordnance with the following indorsement:

> ROCK ISLAND ARSENAL, *January* 16, 1875.
>
> Respectfully returned to the Chief of Ordnance, United States Army. The buildings at this arsenal being included in the proviso of the 5th section of the act of June 20,

1874, the proviso appeared to me to state that appropriations for these buildings should continue available until otherwise ordered by Congress.

D. W. FLAGLER,
Major of Ordnance, Bvt. Lieut. Col., U. S. A., Commanding.

In January, 1875, the following action on this subject was taken by the Chief of Ordnance and the Secretary of War:

WAR DEPARTMENT, *January* 13, 1875.

The Secretary of War has the honor to transmit to the House of Representatives communication of the 6th instant, from the commanding officer of the Rock Island arsenal, with indorsement thereon of the Chief of Ordnance, requesting that the appropriation for that arsenal for the year ending June 30, 1876, be made available upon the passage of the act, and to recommend the same to the favorable consideration of Congress.

WM. W. BELKNAP,
Secretary of War.

ROCK ISLAND ARSENAL, ILLINOIS, *January* 6, 1875.

SIR: I have the honor to request (if you deem it advisable) that Congress be asked to make the appropriations for this arsenal for the year ending June 30, 1876, available for use on the passage of the appropriation act.

The necessity for this action is important from the fact that the estimate asks for funds for the completion of Shop "A," and for the erection of two new buildings—an office, and one block of quarters; and the law of July 12, 1870, requires that the unexpended part of the appropriations be covered into the Treasury at the close of the year. Therefore the buildings have to be completed within the year, (before June 30, 1876,) and to do this the roofs must be on the buildings before winter sets in. As contracts for material cannot be made until after the appropriation is available, and about six weeks must be consumed in advertising for proposals, it is clear that if the commencement of work is defeered till after July 1, an economical completion of the necessary work before cold weather will be difficult.

It is also important because if the commencement of work is deferred until the middle of the season, skilled labor is drawn off elsewhere and cannot be obtained easily and economically.

I do not think the importance and economy of commencing work early in the spring, and of carrying it on carefully and slowly through the whole season, can be overestimated.

As this can be effected by making the appropriation available on the passage of the act, and there seems to be no objection to such action, I would respectfully urge that it may be done.

I have this day sent to you a letter of inquiry respecting the intention of section 5 of an act of Congress approved June 20, 1874. If it is found that the act referred to does not make appropriations for buildings at this arsenal available for a longer time than one year, I respectfully request that Congress may be asked to make the appropriations for this arsenal available for use at least two years after the appropriations are made.

The necessity for this has been explained in my annual reports. For your convenience, I inclose an extract from my last annual report on this subject.

In any case, however, I deem it very important that the appropriations for next year should be made available for use on the passage of the appropriation act for reasons which have been set forth in this letter.

Very respectfully, your obedient servant,

D. W. FLAGLER,
Major of Ordnance, Commanding.

Brig. Gen. S. V. BENÉT,
Chief of Ordnance, Washington, D. C.

[1st indorsement.]

ORDNANCE OFFICE, *January* 11, 1875.

Respectfully submitted to the Secretary of War. The commanding officer of the Rock Island arsenal very clearly sets forth herein the necessity for a proviso making appropriations for the erection of public buildings available on the passage of the act and for the period of two years. His views are concurred in, and it is respectfully recommended that the attention of Congress be called to the subject for favorable consideration.

S. V. BENÉT,
Brigadier-General, Chief of Ordnance.

Extract from the annual report of the principal operations at the Rock Island arsenal, Illinois, during the fiscal year ending June 30, 1874.

* * * * * * *

I would again respectfully call the attention of the Department to the necessity, to this arsenal, for some relief from the operation of the law requiring that unexpended portions of appropriations be covered into the Treasury at the close of the year.

The bad working of the law, particularly as regards economy during the past year, has been somewhat disheartening. I quote what was said on this subject in my last annual report, which explains some of the difficulties arising from the operation of the law at this arsenal:

"I respectfully invite the earnest attention of the Department to the effect upon the operations of this arsenal of the law of July 12, 1870, covering unexpended appropriations into the Treasury.

"In building, an appropriation generally is only sufficient for the operation in hand, and the effect of the law is, then, simply to compel the forced completion of the operation within the year. This enforced completion is difficult of accomplishment, and must almost always be attended with imperfections in the work and considerable additional expense and loss of money. For instance: An appropriation is made for the erection of a building. The money is not available for the work till after July 1, and cannot be obtained till some time thereafter, and the building must be completed before the 30th of June following.

"For most buildings the walls must be completed and the roof put on before cold weather, so that interior work may go on during the winter, *or the building cannot be completed in the year.*

"Under the laws and rules governing expenditures, work cannot be well under way until the latter part of July. There is then left of good weather only August, September, October, and sometimes a part of November, for all the excavation for foundations and basements, (generally in rock—a slow and tedious work, requiring blasting,) and for the completion of the walls and roof.

"The walls are stone, and stone-work involving architecture cannot be hurried satisfactorily. All the operations of getting suitable stone from distant quarries, transportation, cutting, and preparation for the walls are slow, tedious, and troublesome, and unexpected delays are sure to occur.

"The elements of loss in doing work in this manner are as follows: Suitable material cannot be obtained, and high prices must be paid; a quarryman cannot work his quarry to advantage, and must charge accordingly; the contractor at once understands his advantage, and the tendency is to deliver poor material; the officer must sometimes accept material which he would reject were not the alternative the loss of his appropriation and failure to do his work; again, a large force must be employed on the work. This involves the payment of extraordinary wages to get workmen, to pay traveling expenses, and change their abode, when they may be discharged in a few months. Troublesome workmen find out that the Government is in their power, and the system induces strikes. This necessary employment of a large force temporarily, and then a suspension of work, and requiring workmen to lie idle, not only creates great dissatisfaction among workmen and in the community, but also deprives the Government of the advantage of giving workmen regular and permanent employment, whereby they are induced to make this a permanent home, and their services can be obtained at fair, low wages. It is impossible, in most cases, to push walls to completion before cold weather, and the upper and difficult part of the wall must be built in the extreme cold of winter at great loss. The season for advantageous work commences in the spring and closes in the fall. The close of the fiscal year comes just in the middle of that season, and work must gradually stop as the end of the year approaches. This occurring in the busiest part of the season, many of the best workmen are sure to get employment elsewhere before work can be resumed. Little latitude is allowed in making purchases, and they must be made at once, no matter what is the state of the market, and without waiting to draw from distant sources.

"The foregoing are a few of the evils of the system. Great trouble and labor is involved in combating them, and it cannot always be done successfully. I know of few things so heartless and discouraging as to labor diligently and well to accomplish work economically and find oneself defeated unnecessarily.

"The evils spoken of have been in full force at the arsenal during the past year. The rebuilding of Chicago drew off every kind of material and labor required at the arsenal, promoted strikes, advanced prices, and, being forced to accomplish work within a specified time, it was impossible to do it satisfactorily and well at satisfactory prices and keep within the estimates.

"I believe that none of these facts are new to the Department. If the Department deem it practicable to get from Congress any modification of the law, I respectfully urge the great advantage to this arsenal of such a modification as will make appro-

priations for public buildings at this arsenal 'permanent appropriations,' or available for three years or two years, instead of one, and I respectfully request that some action to this end may be taken.

"D. W. FLAGLER,
"*Captain of Ordnance, Bvt. Lieut. Col., U. S. A., Commanding.*"

On May 4, 1876, I wrote to the Chief of Ordnance as follows:

I have the honor to communicate for your information the following:

An appropriation was made by Congress last year for transmission and water-power machinery for furnishing power to the shops at this arsenal.

The character of the machinery was such, that time, certainly a year, was required for its manufacture, if regard was paid to economy and perfection. The machinery could not, therefore, be made and put up last fall. It is now nearly completed, but cannot be put in during the present high water in the river. This high water will last until after July 1st, and the work cannot be done with advantage until low water this fall.

Section 5 of act of Congress approved July 12, 1870, (chap. 251, vol. 16, p. 230, Revised Statutes,) requiring that unexpended portions of appropriations be covered into the Treasury at the close of each fiscal year, practically requires that the work be completed before July 1st, unless the time for doing the work can be extended. If this is not done, the use of the machinery manufactured must be lost for some years.

I therefore respectfully request, if you should deem it necessary, that application be made to Congress for permission to continue for use at this arsenal until June 30, 1877, any unexpended portions of appropriations for this arsenal that may be on hand at the close of the present fiscal year.

To show the loss to the Government which must result from the operation of the act of July 20, 1870, in its application to building and engineering operations at this arsenal, I respectfully refer you to my letter of June 6, 1875, and my annual reports for the years 1873 and 1874.

With the hope that relief from the operation of this law may be obtained without application to Congress, I respectfully refer you to my letter of January 6, 1875, a copy of which is introduced here.

(This is the letter transmitted to Congress and copied a few pages back.)

During the last session of Congress, (I think in January, 1875,) application was made by the Chief of Ordnance to Congress for such action as would make appropriations for the arsenal available for use for a longer time than one year. I was informed after the close of the session by the member of Congress from this district, Hon. J. B. Hawley, that this application was referred to the Committee on Appropriations, and that that committee took no action in the matter; but he stated that the intention of section 5 of act approved June 20, 1874, (sec. 5, chap. 328, p. 110 of Statutes passed by first session of the Forty-third Congress,) was to grant exactly the modification of the act of July 12, 1870, that was asked for, and that, therefore, no further action was necessary.

Mr. Hawley also informed me that on account of the importance of the matter to the interests of this arsenal he called upon the accounting officers of the Treasury for a decision as to the application of section 5 of act approved June 20, 1874, to appropriations for this arsenal, and I inclose herewith a letter from Mr. Hawley on this subject.

In view of its importance to the interests of this arsenal, I respectfully ask for such action in the matter as you may deem advisable.

Very respectfully, your obedient servant,

D. W. FLAGLER,
Major of Ordnance, Commanding.

The following is a copy of Mr. Hawley's letter referred to in the foregoing communication:

ROCK ISLAND, ILLINOIS, *May* 2, 1876.

Colonel D. W. FLAGLER,
Commanding Rock Island Arsenal:

DEAR SIR: Yours of yesterday, with inclosures, just received. I remember very well your communication, referred by the Chief of Ordnance to Congress, upon the subject of covering into the Treasury unexpended balances at the end of the fiscal year.

A year ago last winter I called the attention of Gen. Garfield, chairman of the Committee on Appropriations, to your letter, and he was clearly of the opinion that section 5 of act of June 20, 1874, was sufficient to prevent the covering into the Treasury

of balances of appropriations made for the construction of buildings at Rock Island arsenal.

I concurred with him fully in that opinion, and, for the purpose of ascertaining what would be the action of the Treasury Department upon the law, I called upon the First and Second Comptrollers of the Treasury and presented the question to them, and was informed by both of them that they had consulted together in regard to it, and were of opinion that balances of appropriations for such buildings were not covered into the Treasury.

I so wrote you soon after, advising you of what I had done, and assuring you that you would find the then existing law in its administration all that you would desire.

Respectfully, your obedient servant,

JNO. B. HAWLEY.

On the 10th of August, 1876, I wrote again to the Chief of Ordnance, as follows:

Referring to my letter of May 4, 1876, respecting the impracticability of putting in water-wheels and other mill-machinery under the appropriation of last year, unless the time for doing the work was extended until the season of low water in the river this fall, I have the honor to ask if any decision is obtained which will permit the work to be done this fall, that I may receive instructions as soon as is convenient.

I had nearly completed the manufacture of the water-wheels and machinery on the 30th of June, when under par. 5 of act of Congress approved July 12, 1870, the work had to stop.

I have left (unexpended) $3,625 of the appropriation for this work, which is sufficient for putting in the machinery and commencing the use of the water-power, if authority could be obtained to use it.

The season of low water, during which it is practicable to put in the machinery with any regard to economy, will be over about the last of October, and there is left now only about sufficient time in which to do the work well.

If the machinery had been put in within the limit of time which the act of Congress above referred to gave for completing the work, then it must have been put in during the high water of last May and June. This would have required new coffer-dams of great strength, 22 feet high, and that the water be pumped out to a depth of over 20 feet. This alone would have cost more than all the money required and available for putting in the machinery and completing the work.

This letter was returned with the following indorsement:

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, Aug. 14, 1876.

Respectfully returned to the commanding officer of Rock Island arsenal.

Legislative action was requested to enable the expenditure of the appropriation made for this purpose to be continued after July 1st, but no action has been taken by Congress on the subject.

S. V. BENÉT,
Brigadier-General, Chief of Ordnance.

Appendixes to Chapter VIII.

A.

Report of the principal operations at the Rock Island arsenal during the fiscal year ending June 30th, 1872.

The sixth section of the act of Congress approved April 20th, 1871, made the appropriations to this arsenal available for use at once. In accordance therewith a portion of the appropriations were expended before July 1st, 1871, and this report includes those expenditures and the operations under the same.

ROCK ISLAND ARSENAL.

Water-power.

The work upon the water-power for the year has been, mainly: The building of the canal and the completion of the same, nearly; the building of the stone dike and the completion of the same, nearly; the completion of the upper-dam wall, (generally known as the Moline dam,) and the building of the wing-walls to receive the end of the

stone dike, and the building of the dike to prevent the overflow of the Moline Water-Power Company's land. Previous to the beginning of the year, work upon the water-power had been carried as far as the building of the upper stone dam to its intersection with the temporary "bulk-head;" the completion of the island shore dike; a partial excavation of the canal, and the building of a portion of the stone dike. The temporary "bulk-head" referred to is shown on the map, and was put in by the Moline Water-Power Company for the purpose of enabling them to use the water-power until the lower dam should be completed. When building the stone dike, coffer-dam No. 2 inclosed the part of the river where the dike is situated, and the bed of the river within the coffer was kept dry by pumping.

The Moline Water-Power Company used the water-power during this time, their tail-water escaping between coffer No. 2 and the uncompleted end of the dam-wall. A contract between the United States and the Moline Water-Power Company required that this gap for the escape of the company's tail-water between the unfinished ends of the dam and the stone dike should be left open until the dike should be completed to that point, and there should be left in the canal only sufficient material to complete the dike and close up the gap. Then the company's gates were to be closed and the water shut off, while the gap was being closed and the canal finished.

Work for the year ending June 30, 1872, includes also work done from June 5th to June 30th, 1871. Ten days were consumed in pumping out the coffer. The force of workmen on the canal was then gradually increased until June 30th, when the daily expenses had reached about $1,000. From that time till the close of the season about 900 laborers and 75 teams were employed on this work, the daily expenses averaging about $1,250. The dimensions of the canal and the stone dike are shown in the accompanying drawing, marked "A."

The core shown in the cross-section of the stone dike is composed of a béton of hydraulic cement and finely-broken rock. The slopes of the dikes are covered with very excellent dry slope walls, (generally called riprap in this report.) These walls have their foundation on bed-rock under the river, and are sustained from slipping by a slight excavation and heavy riprap, shown in the drawing. Total excavation of earth from the canal during the year was 3,793 cubic yards; total excavation of rock from canal during the year was 87,674 cubic yards; total rock hauled to and used in building stone dike, 12,451 cubic yards; total béton core built, 3,843 cubic yards; total earth dike built, 2,600 cubic yards; total riprap laid, 14,727 square yards; masonry laid in upper-dam wall and in wing-walls to receive the upper end of the stone dike, 345 cubic yards; masonry in piers and abutments of bridge over canal, 36½ cubic yards.

Throughout the season the work upon the water-power had been so arranged that the canal, the stone dike, and the upper dam should be completed before winter set in. This was necessary because the high water in the spring would probable prevent the economical resumption of work before the latter part of June, and it was desirable that all the upper part of the development should be completed during the year. The work would have been completed about the 5th of November had not the Moline Water-Power Company raised a controversy respecting the dimensions of the canal. In accordance with a written notification to the Moline Water-Power Company, dated August 22d, 1871, their gates were closed on the 15th of October, 1871, and new coffer-dams (marked "No. 3," on map A,) closing their tail-race were put in, and the work of closing the gap, by completing the stone dam and the stone dike, was commenced.

In reply to my notification, I received from the president of the Moline Water-Power Company a protest against the work, and it was then that the controversy referred to above began. It was claimed by the Moline Water-Power Company that the canal was both too narrow and too shallow; that it should be widened about fifty feet and deepened about three feet. I think it was clearly shown in the discussion of the matter that the canal was being completed with the dimensions agreed upon between General Rodman and the Moline Water-Power Company, and, moreover, that its capacity was all the company had a right to claim or ask for under the contracts they had made with the Government, or upon any plea of justice or economy. For a full discussion of the matter, I respectfully refer you to my letter to the Chief of Ordnance, dated October 24, 1871, inclosing a copy of the protest (against the work) from Mr. Charles Atkinson, president of the Moline Water-Power Company. (See Chapter VIII.)

To prevent future difficulty, I recommended that the canal be deepened one foot at its upper end, and one foot and three inches at its lower end. This recommendation was approved by the Chief of Ordnance in a telegram, dated October 30th, 1871, and the necessary change in work was commenced. Owing to the character of the rock to be excavated, it was extremely difficult and in most cases impossible to quarry out exactly one foot from the bottom of the completed parts of the canal. The attempts to do it made the work slow and tedious, and as the blasts would generally take out two feet or more, and the additional rock blasted had to be hauled away, the work became very expensive. It was estimated that the change in depth of the canal would delay its completion about one month, but although strenuous efforts were made, I failed to

complete the work during the season. Early in December heavy rains and cold weather set in, delaying the progress of the work. December 22 the coffer-dam was broken by a heavy rain, and a few days afterward the thermometer fell to 16° below zero, the pumps could not be worked, and the work had to be abandoned. There was left about 3,400 cubic yards of rock to be taken out of the canal, and about 700 cubic yards of stone to be placed on the dike, and about 1,588 square yards of riprapping to complete the dike. This work will be completed this fall when the water is at its lowest stage. The total cost of the work still required to complete the dike and canal will be about $5,000.

I estimate the expense to the United States of lowering the bottom of the canal as it has been done, to be fully $29,642.07. It will be understood from the foregoing that the canal was so far completed that it could be used. The stone dam was entirely completed, the stone dike so nearly completed that it could be used with perfect safety, and so little material was left in the canal that I estimate its capacity to be diminished thereby only about 6 per cent.

When I was forced to suspend operations, I cleared out my coffers and permitted the Moline Water-Power Company to open their gates and use the canal as a tail-race. This was done on the 30th day of December, 1871, and water first flowed through the canal on that day. They are still using the water-power in this manner.

Subsequent observations have convinced me that the capacity of the canal is sufficient for the purpose for which it was designed. In answer to verbal inquiries, individual members of the Moline Water Company have said to me that they were entirely satisfied with the canal. My experience leads me to the opinion that no more convincing proof of the sufficient capacity of the canal could be required than the fact that the president of the Moline Water-Power Company has made no further complaints and protests against the work. I hope there will be no further controversy respecting it. The accompanying drawing, marked "C," shows the method of completing the Moline dam and of the wing-walls to receive the stone dike. The total expenditures on the water-power during the year was $196,433.69. The total appropriation was $200,000. In previous years the expenditures upon the water-power had exceeded the amount designated for the same under "Rock Island arsenal" appropriations by $24,165.17. I had expected to equalize this expenditure last year, but was prevented by the necessity for deepening and completing the canal.

WORK ON UNFINISHED SHOPS B AND C.

The present designation of shops by letters is that shown on the accompanying map, marked "B."

Shop B.

This shop, heretofore known as No. 1, was commenced in October, 1866. During the past year it has been painted throughout, the iron parts requiring two coats and the wood-work three. The iron parts painted are the roof-frame complete and the columns and floor-joists. The wooden parts are the interior of the wooden roof, sheathing and rafters, and the doors and windows. Two of the four iron staircases have been commenced and nearly completed. Outside the building all the area walls have been built of stone and completed, except along the east front on First street; and all the entrance-steps have been built except on the east side. The steps are of stone, massive and substantial, and have been built to fourteen of the doors. The total length of area-wall built is 1,250 feet. The court between the wings has been graded, requiring the excavation and removal of a considerable amount of rock, and has been paved 10 inches in depth with finely-broken rock. The ground has been graded on all sides of the building except the east side, sodded, trees planted, and flagstone walks laid. The total amount of stone walk laid is 566 feet 5 ft. wide, and 414 feet 8 ft. wide.

Shop C.

This shop was commenced in September, 1867, and had been completed so far as the building of the walls, putting in the iron columns and floor-joists, and putting on the iron roof-frame. During the year the wooden roof sheathing and rafters have been put on, and the roof slated; all the copper-work of the roof and the conductors and down-spouts put on and completed. The doors and windows have been put in and the latter glazed. The fire-proof-brick arches have been put in for all the floors, and the floors laid and completed and the ceilings plastered. The steam-heating pipe has been put in, and the building painted in the same manner as Shop B. The iron staircases have been commenced, and the whole building completed to the same extent as Shop B, except the outside grading, the steps, and area-walls. The total expenditure on these two shops, after the appropriations for the year were made available, was $103,598. A portion of this, $13,000, was taken from the appropriation for the year ending June 30th, 1871. The remainder, $90,598, had to be taken from the appropriation

for the shops for the year ending June 30th, 1872. The two shops are now entirely completed, except the stone steps and areas for Shop C, and the iron stairways and basement pavements for the two shops. I estimate the total cost of the work yet to be done to be $24,000. The work of paving the basements has been delayed for the purpose of making experiments upon and investigations respecting concrete pavements. It was thought that concrete pavements might be both more durable and economical than stone. I have pursued these investigations as far as practicable throughout the year, and have had three samples of concrete pavements laid (at the expense of the parties proposing to furnish the pavement) and tested, but the results have not been very satisfactory. I do not think a reliable and durable concrete pavement—say one that will be certain to last more than five years—can be obtained at present, except from the natural asphaltum, and this last produces a more expensive pavement than stone. A mixed or compounded concrete that will possess just the proper toughness and hardness cannot be produced with much certainty, and after it is laid the underlying earth, gravel, or broken rock seems to abstract the oil and other cementing material from the concrete. Eventually the hard top crust of the pavements is broken, and the under part is found to be dry and brittle, and crumbles like gravel. Respecting the natural asphaltum, there are other objections, besides its cost, to its use for shop pavements. Its dark color absorbs much of the limited light in the basements. When covered with dust, which it retains, it produces in a basement the effect upon the eye of an unpaved dirt floor. The more serious objection, however, is that, in the future operations of the shops, particularly of the armory, it will be necessary to lay, alter, and repair water and steam pipes and sewers and drains and sewer-traps under the pavement floors. When the concrete is once laid, it is torn up with great difficulty, and cannot then be repaired. A suitable concrete pavement can be produced for from 40 to 50 cents per superficial foot. A suitable stone pavement can be produced for about 35 cents per superficial foot. It will be necessary to pave the basement of Shop C during the coming winter, preparatory to its occupation as a shop, and it is proposed to pave it with flagstones from 4 to 5 inches thick, except a roadway along the center, which will be paved with rubble set on edge.

NEW SHOPS COMMENCED.

Shop D.

Excavations for this shop were commenced early in May. Nearly all the excavation was rock, requiring blasting. Considerable difficulty was encountered in obtaining good foundations for this building. I inclose herewith a drawing, marked "D," showing the character of the earth and rock passed through in excavating for foundations. On the drawing several clay "pockets" are shown and marked "N." The worst of them is the one marked "N M." The following report from the officer in charge of the work describes the character of these "pockets," and the method employed in this case for securing a foundation:

"Foundation of Shop D.

"The site was occupied by a number of old frame buildings which had been used as hospitals during the existence of the rebel prison at this post, and afterward as temporary store-houses. Their destruction was commenced in the latter part of April, 1871, and excavation began in the early part of May. After excavating the cellar it was necessary to obtain a firm foundation for the walls. Previous experience had shown that what appeared to be solid rock was sometimes but a thin sheet, overlying clay. The necessary foundation was attained with considerable difficulty and the expenditure of a great deal of time and money. Through the northern extremity of each wing ran a seam of red, yellow, and white clay, which when moist was very yielding, though when dry so hard as to require the use of a pick for its removal. This seam was about thirty feet (30) in width, its depth unknown, as after penetrating 34 feet vertically at one point water began to pour in. In the west wing a sewer which carried off the water from the roof of the adjoining shop (B) burst in the evening after a heavy rain, and by morning had flooded the excavation. The water disappeared in the course of the day, running off by a subterraneous passage, not apparent at that time. The recommencement of the rain put an end to the work for that day, and by the next morning a large area of earth had fallen into the opening. This had to be removed, and from that time it was necessary to use a sheathing of boards supported against the inward pressure of earth by strong frames. When the bottom had been reached again heavy rains rendered the clay so plastic that large limestone bowlders (some of which weighed over three tons) contained in it slid toward the excavation, carrying in the sheathing. It was necessary a third time to remove the material, and the broken boards and beams made the operation slow and difficult. This time, owing to the cessation of the rains, strength of the sheathing, and constant precautions, the

excavation was successfully and securely carried down to the water-level. On increasing the length of the cutting a wide cavern was found passing from the center of the west wing across the foundatton in a southeasterly direction. The bottom of the cavern was covered with sand and the ripple-marks showed it to have been a water-course. An old well, 30 feet deep, in the east wing of this building, had been used as the receptacle for water flowing from the roof of Shop B. It never retained any water, even after the heaviest rains, and the indications are that it found exit through the cavern described above. To obtain a sound footing for the walls of the building above the part of the excavation heretofore described, a 'core of béton' was laid, the upper surface being convex, and on the center thus formed an arch of seven consecutive courses was laid, which abutted at either end on solid rock; 270 cubic yards of stone were laid n this hole alone. It was necessary to construct arches in five different places. The foundation for the regular courses was made of stone obtained from a quarry on the island at the ferry-boat landing.

(Signed) "CHAS. SHALER, JR.,
"*Lt. of Ordnance, in Charge.*"

The difficulties in securing foundations for this building delayed the work considerably, and the work was further delayed by the insufficient supplies of building-stone received from the contractor. During the year the foundations were completed, the basement-story built, the water-table set, and the iron joists and girders for the first floor purchased and prepared for setting.

Shop E.

This shop is the arsenal blacksmith-shop. The architecture is the same as that of the other shops, except that it is only one story high, and the walls, having no upper floors and less weight to sustain, are thinner. The roof will also have a hood, for increased light and ventilation. The grade of the floor of this shop is so established that the ground in front of the shop will fall from Main avenue to the building nearly 2 feet in 100 feet to reach the sills of the front doors. The floor will then fall 10 inches in 100 feet to the south end of the buildings, thus accommodating the floor to the grades of the streets and avenues, so that carts and wagons can enter at all the doors.

Less difficulty was experienced in obtaining foundations for this shop than for Shop D, though several troublesome "pockets" were encountered; and the same delays occurred in the deliveries of building-stone by the contractor. During the year the foundations were completed and about one-half of the walls above the water-table were built.

I have also to state that the important and expensive work done on the other shops (B and C) and upon avenues and roads, bridges and sewers, so reduced the appropriations that the work upon these buildings was not advanced so much as it would seem that it should have been.

Grades.

The grades of streets, avenues, and grounds about the shops, so far as they have been established to accommodate them to the general plan of the shops, are shown on the accompanying map, marked "B."

Boiler-house and chimney for Shop C.

The plans for boiler-house and chimney and engine-rooms for Shop C were approved by the Chief of Ordnance while he was at this arsenal in October, 1871.

During the year foundations for the chimney and stone pedestal, and the stone pedestal, 18 feet high, were completed; also the light-colored Milwaukee pressed brick for the outer facing of the chimney-stack were purchased.

The foundations of the boiler-house were completed and some progress made on the walls. A 120-horse-power Corliss steam-engine for this shop has been received from the Springfield armory.

OFFICERS' QUARTERS.

The commanding officer's quarters were completed during the year, and the two sets of subaltern officers' quarters, commenced during the year, were very nearly completed. Serious trouble and delay occurred in the work on the subaltern officers' quarters from the non-delivery of stone by the contractor.

SEWERS

No system of sewerage for the shops and streets and avenues had been adopted previous to this year, except that sewers had been built under Shops B and C. There was, however, no drainage from these sewers or from the basements and areas of the shops,

and it was necessary that the work should be done at once. Although there was no special appropriation for the work, it was thought best to construct permanent sewers, because any temporary device for the purpose would be attended with considerable expense, which expense would afterward be wasted when permanent sewers should be built.

The plan adopted is shown in the accompanying map, marked "B." The map has also drawings showing cross-sections of the sewers, profiles showing the fall of the sewers, and drawings of vertical drains (with stench-traps) from the shop-areas and gutters of streets and avenues. The down-spouts from the shops will also generally discharge into the sewers.

The excavation for the greater part of the main sewer was necessarily very deep, as shown on the drawing, and was generally through rock, requiring blasting. The main sewer and the North-avenue sewer were completed, and about one-third of the South-avenue sewer was built during the year.

The total cost of the work was $16,915. The money for the work was necessarily taken from the appropriations for the shops. The main sewer discharges below low water, in Sylvan Water, at a point about 200 feet below the water-power dam.

AVENUES AND ROADS.

The only work of importance on avenues and roads during the year, except necessary repairs, was the building of North avenue and repairs of the Rock Island wagon-bridge and causeway.

NORTH AVENUE.

The building of a portion of this avenue was necessary for the prosecution of the work on Shop D. As the excavations for basement and foundations for Shop D furnished nearly all the material required for building the avenue, it was thought best to complete the work. The avenue is 60 feet wide and 1,680 feet long. It is perfectly graded, and paved to a depth of 10 inches with finely-broken rock. Only a strip 24 feet wide along the center of the avenue has been covered with gravel.

ROCK ISLAND WAGON-BRIDGE.

During the year the roadway of this bridge has been replanked with 3-inch oak plank. The old floor was of pine, and so much worn as to render it unsafe. Also the piers have been heavily riprapped nearly up to the surface of high water, to protect their foundations from washing.

The foundations of one of the piers had received some injury and been endangered by washing during a freshet through that channel of the river. Considerable repairs were also made upon the slope-walls which sustain the causeway leading to the bridge. This work was absolutely necessary for the preservation of the bridge and causeway and to make the roadway of the bridge serviceable. The total cost of this work, of building North avenue, and of all repairs of roads and avenues, grading about the shops, and laying of flagstone walks, planting of trees, &c., was $19,673. The total number of shade-trees planted is 1,350.

OTHER WORK DONE.

A good deal of work has been done and much expense incurred in necessary repairs of the temporary wooden buildings now in use at this arsenal for barracks, officers' quarters, and other purposes. One temporary set of officers' quarters has been constructed from one of the old prison-buildings, and one permanent ice-house has been built. Six old wooden buildings have been taken down and removed from the site of the new buildings and improvements. Considerable repairs have been made on the water-reservoir.

WATER-PIPE.

Two thousand eight hundred and seventy-nine (2,879) feet of 8-inch water-pipe and 454 feet of 4-inch water-pipe have been purchased during the year. This pipe has not yet been laid. I should prefer not to lay it until the pump is removed to the water-power dam; then, by using the supply-pipe to the reservoir as a water-main, about 1,200 feet of pipe can be saved.

D. W. FLAGLER,
Capt. of Ordnance, Bvt. Lt. Col. U. S. A., Comdg.

ROCK ISLAND ARSENAL, *September 26th*, 1872.

NOTE.—So much of the above report as relates to the manufacture, cleaning, and repairing of ordnance and ordnance-stores, issues to the Army, &c., is omitted here.

B.

Annual report of the principal operations at the Rock Island arsenal during the fiscal year ending June 30th, 1873.

ROCK ISLAND ARSENAL WATER-POWER.

The work on the water-power during the year has been, mainly, the construction of an iron wagon-road bridge across the water-power canal; the completion of the canal; the completion of the stone dike which separates the water-power pool from the tail-race; work on the dikes to prevent the overflow of the Moline Water-Power Company's lands; work on the Sylvan Water dam and stone dike.

THE CANAL WAGON-ROAD BRIDGE.

The agreement between the United States and the Moline Water-Power Company required the United States to build a bridge over the tail-race canal, which cuts in two said company's land. Work on the bridge was commenced in July, and the bridge was completed, ready for travel, in September. The location of the bridge was fixed by the Moline Water-Power Company, and its axis is placed in a vertical plane, containing the center line of a future street. It is for this reason that the axis of the bridge is not perpendicular to the axis of the canal. The angle between them is 81°. The faces of the abutments and the axis of the pier are placed parallel to the axis of the canal, and the pier is made as thin as is consistent with the strength required, in order that the least resistance may be opposed to the current, and that the current may not be obstructed, the faces of abutments are placed back of the wall-lines of the canal, enough more than to compensate for the cross-section of the pier, and to give an increased cross-section of water at the site of the bridge. Considerable difficulty was encountered in getting good foundations for the abutments. Unfortunately the site selected by the Moline Water-Power Company was almost the only one where there were not good foundations for masonry. There were pockets of clay under both abutments, and under the south one a spring of water. The rock was blasted, and the clay and rock taken out to a depth of about 10 feet below the bottom of the canal for both abutments, before good foundations were found; and as water was flowing in the canal at the time, pumps and dirt coffers were required. The superstructure of the bridge consists of two spans, each 87 feet long; width of roadway, 14 feet 9 inches, with no sidewalks. The truss is a double quadrangular, without main posts, the ends of the top chord resting on stone piers, and the top chord answering the purpose of a railing. The truss will carry a moving load of 24,000 pounds, straining the iron to $\frac{1}{4}$. Complete drawings of the bridge are inclosed herewith. Care is taken to make a full report respecting this bridge, in order that the Department may be in possession of knowledge showing that the terms of the contract between the United States and the water-power company have been complied with.

THE WATER-POWER CANAL.

My annual report of last year shows the condition of the canal at the close of that year.

Work on the canal was resumed October 14th, and the canal finally completed November 27th. As it was necessary that the gates in the upper dam should be closed and the water-power company prohibited from using water during the progress of work in the canal, the work was pushed as rapidly as possible, even at the expense of economy. Two thousand four hundred cubic yards of rock were taken out of the bottom of the canal, and 275 cubic yards of paving and 1,692 yards of riprap were put on the dike. Work on the dike was prosecuted until the latter part of December, although the canal was completed, the gates opened, and the use of the water-power resumed, as stated, in November. During the progress of work on the canal, a difficulty occurred with mill-owners who use the water-power, involving the jurisdiction of the United States over the dam and gates. Gates were opened by mill-owners without authority, and water discharged through the canal, making it necessary to suspend work, and endangering the light mud coffers which were used; and armed parties stationed themselves on the shore, who threatened to shoot any one who closed the gates. It was necessary to use soldiers to get the gates closed and keep them closed.

That the Department may have in its possession full knowledge of the manner in which the canal was completed, this being involved in the controversy respecting the grade at the bottom of the canal, I append hereto a map, marked "B."

SYLVAN WATER-DAM.

(NOTE.—This is the lower dam, where the water-wheels for furnishing power for the arsenal will be placed.)

The work of building this dam has been prosecuted in accordance with the plans approved by the Secretary of War in July, 1872. To secure the greatest amount of

power from water-wheels, it was necessary to excavate to a depth of 7 feet below estimated extreme low water in the future tail-race, when no water should be running through the gates. The plans for the dam required this excavation to extend in between the counterforts, and so close to the main wall that the excavation could not be made with safety after the wall was completed and whenever it should become necessary to put in wheels. The excavation had therefore to be made before commencing the wall.

The bed-rock of the river along the line of the dam was found to be generally insecure, full of seams and clay pockets, and did not furnish good foundations. Also, it was generally shattered in blasting out the wheel-pits. The excavation for wheel-pits was therefore carried back to the up-stream side of the main wall, and the whole wall had then to be built up from the bottom of the wheel-pits. This greatly increased the estimated amount both of excavation and masonry. The increased amount of masonry was about 30,000 cubic feet. The total excavation of rock was increased from an estimate of 53,000 cubic feet to about 88,000 cubic feet. Difficulty was encountered in securing secure foundations for the wall in several places. Before fixing upon a site and plans for the dam, soundings were made to ascertain the character of the bottom of the river, and these soundings indicated generally a sound rock bottom. After fixing upon plans for the dam, and for transmitting the power, the selection of the site was confined within narrow limits; that is, the necessities of the case required that the dam be very nearly on the line laid down on the map approved by the Secretary of War, or a complete change of plan. After coffering the river and pumping out the water, a thorough examination of the bed of the river with a drill showed the existence of clay "pockets" and seams, and that considerable trouble would be encountered in getting good foundations. However, the rock was about as secure along the line already fixed upon as anywhere else, and it was determined to build upon that line. These clay "pockets" were similar to, though none were so bad as, those found in getting foundations for Shop D, fully described in my last annual report. The danger for the dam-wall was that if it did not extend below the seams and pockets the head of water on the up-stream side of the wall would hereafter force a passage through the seams under the wall, and, washing out the clay and loose material from seams and pockets, would destroy the foundations. Great care was used, and I believe the foundations are everywhere secure. These difficulties, and the increased excavation and masonry described, delayed the work and increased its cost. The wall was pushed nearly to completion, but it was impossible to complete dikes, gates, &c., and rendered necessary the estimate for the completion of the work which is contained in my annual estimate for next year; also the alteration in the form of the canal was made after my estimate for completing the water-power was made, and the additional cost of the canal, a little more than $29,000, was not provided for in that estimate. The causes of this change in the canal are fully explained in my last annual repot. I inclose a map showing the location of coffer-dams and pump used in the prosecution of work on the dam. Last spring a "gorge" of ice formed across the main channel of the river, from opposite about the center of the island to the Iowa shore. The damming of the river caused the water to rise rapidly in the water-power pool above the head of the island. The ice in the pool at the time was 40 inches thick. When the ice gorge broke, the sudden subsidence of the water forced the great cake of ice in the pool down against the small dam between Benham's and Rock Island, (generally known as Sears's dam,) and carried away about 80 feet of it. The part carried away has always appeared to me insecure, and I had intended to strengthen it. The part remaining is strong enough when the broken gap is filled up. The loss of water through the gap caused a large loss of power by drawing down the head of water in the pool, and in April I filled up the gap to the surface of the water at ordinary stages. To prevent danger to the rest of the dam during the coming winter and spring, it is necessary to complete the work this fall. About 16,500 cubic feet of rock are required for the work. I hope to get this at a small cost from contractors on the river improvements, who will be taking rock from Duck Creek chain this fall.

A report made by Lieut. Charles Shaler, jr., describing the ice-gorge and freshet and the method of filling the gap in Sears's dam, is appended hereto.

I deem it my duty to call the attention of the Department to a serious defect that exists in the water-power, and for which I can find no satisfactory remedy. This is the sedimentary deposit that is forming in the pool. The strong current along the Illinois shore above the town of Moline cuts into the shore, and the water becomes charged with sand and prairie-loam. This deposit is brought down the river till the current reaches still water. This is at what is known as the "mouth of the pool," a line joining the head of the wing-dam with the Illinois shore. Along this line the current impinges against the still water in the pool. A portion of the water is pressed out around the head of the wing-dam into the main channel, and the remainder entering the pool becomes quiet and deposits its sediment. A bar is thus forming across the mouth of the pool, and extending down the pool toward the dams. At low water the cross-section of current at the mouth of the pool is already so much reduced as to

interfere greatly with the efficiency of the water-power, and the bar is rapidly increasing. If the extreme of cold comes this winter before there is a rise in the river, I fear the formation of ice will consume nearly all the cross-section of water there is at the mouth of the pool, and that the water-power will be stopped during the winter. I know of no way of removing the bar except by dredging; but as the deposit will continue, the dredging must continue indefinitely, and be a constant expense. I hope that during the fall I will be able to make surveys and soundings of the pool, sufficient to form an estimate of the amount of deposit annually, and the cost of removing it.

PERMANENT BUILDINGS.

Shops.

Shop D is a finishing-shop for the armory. Work on this shop has progressed fairly throughout the year, and has consisted mainly in the purchase and stacking for seasoning of the lumber required for the buildings; the purchase of the iron beams required for all the floors, the putting in of the beams for first floor, and the progress of the walls nearly to the completion of the second story.

Shop E is a foundery and forging-shop for the arsenal. Work on this shop has been pushed as rapidly as possible throughout the year, and the building has been completed, except a portion of the roof and hanging of the doors and windows.

In accordance with a plan approved by the Chief of Ordnance in 1871, I am putting a hood on the roof for ventilation and light. I inclose drawings, showing the construction of the hood. It has a galvanized-iron cornice, and is covered with corrugated galvanized iron.

In both exterior and interior appearance this building more than realizes my highest hopes. I think the Department may feel sure that it is the finest forging-shop in the world.

Shop C.—The work on shop-fixtures for this shop has been in progress throughout the year. The chimney stack and boiler-house have been completed and the boilers purchased, and the work of setting them was in progress at the close of the year. The cast-iron front for the battery of boilers was cast and finished in temporary shops of the arsenal, and all the castings for shop-fixtures, hangers, pulleys, journal-boxes, couplings, &c., were manufactured in the arsenal-shops. (This work, which was in progress at the close of the year, has, at the present writing, been nearly completed, and the new engine commenced running on the 16th of August, 1873. A full report of the work should accompany the annual report for the present year.)

Barracks.

This building, which was commenced July 1, 1872, has been built and completed in accordance with the approved plans.

In submitting plans for the building, it was explained that it was intended to follow nearly the architecture of the shops, though considerable changes in the character of the masonry were proposed and adopted, and the walls have been built accordingly.

For economy and appearance the face of the wall is range rubble-work, without tool-marks, instead of the heavy ashlar used in the shops. All the caps, sills, jambs, and entablature are full-dressed, chiseled, and bush-hammered work, and the intercolumns, or spaces between pilasters, are twice as great as in the shops. The effect of these changes is fully satisfactory. Besides the economy effected, the appearance of the building was greatly improved, and the barracks is one of the handsomest buildings, in external appearance, at the post. The interior arrangements for kitchen mess-rooms, sewerage, water-supply, heating, bakery, pantries, store-rooms, and water-closets are very complete. The bath and wash rooms are placed on each of the barrack-floors. Owing to the unsettling of prices of labor last season, consequent upon the rebuilding of Chicago, the difficulty in procuring stone rapidly enough, and other causes, explained further on in this report, the cost of the building exceeded the estimate, and it was necessary to leave the third story partly unfinished. The plastering and a part of the wood-work of this story is undone. As this story may not be required for use for many years, I recommend that it be left as it is till wanted. The barracks will accommodate six families (married men) and 170 men.

Magazine.

This building has been built and completed in accordance with the approved plans.

Bridges.

The Moline bridge.— * * * * *

(NOTE.—The description of the bridge and account of its construction have been copied and embodied in this chapter, under the head of "Moline bridge," and are omitted here.)

* * * * * * *

There is yet required a riprap slope-wall on the east side of the Moline approach. It could not be built during high water without great expense for coffering.

Rock Island bridge.—In obedience to orders of the Secretary of War, dated January 29, 1873, this bridge was turned over to the Ordnance Department February 4, 1873. No drawings or descriptions of the bridge were turned over, and, they being necessary in its care and preservation, I made application for them by letter dated May 3, 1873, upon receipt of a letter from the Chief of Ordnance dated June 8, calling for copies of drawings and a report upon the bridge. I again made application for the drawings, and was informed, verbally, some time afterward, that the officer in charge of the drawings had orders from the Chief of Engineers to make copies of the drawings for the use of the Ordnance Department, and to send the originals to the Engineer's Office. While writing this report I have received the drawings, but as they must be retained here until copies can be made for use at this arsenal, I deem it advisable to postpone the description of the bridge, required by the Chief of Ordnance, till the drawings can be transmitted.

Work done upon the bridge during the year.—A double track of iron rails had been laid on the wagon-road of the bridge. The track was adapted for the use of horse-railroad cars, should such cars ever get access to the bridge, and at the same time it was intended that road-wagons should use the track. Unfortunately the form of the rail was not adapted to road-wagons and carriages, and proved a serious obstruction. It has been taken up and a new one substituted. The latter can be used by horse-cars should it ever be necessary. I append a drawing showing a full-sized cross-section of the two rails and construction of tracks.

The draw.—Considerable difficulty has been experienced in operating the draw. The machinery for operating it consists of a steam-engine driving a pump, which operates two hydraulic jacks. The jacks are attached to the draw, one on each side, over the draw-pier. The piston of a jack raises a rod vertically; on the top of the rod is a pulley and a wire rope, with one end attached to the draw-pier, the other to the draw, (only 17 feet from its center,) runs over the pulley. An upward motion to the pulley moves the draw. One jack opens, the other closes, the draw. A safety-valve regulates the pressure the pump may give. As originally constructed, the lever on the valve had on it a weight of 40½ pounds. When the weight was pushed to extreme outer end of lever the pressure was still insufficient to move the draw. To remedy this another weight of 30 pounds was attached to the first weight, and both pushed to extreme end of the lever, and the pressure was then just sufficient to move the draw. I presume the machinery was constructed to stand only the pressure obtained in conjunction with the first weight. The additional weight increases the pressure from 2,629 pounds per square inch to 4,462 pounds per square inch. At any rate, the machinery is not strong enough for the last pressure. The wire rope has broken once, and the hydraulic cylinders have burst three times. These I have been obliged to renew at considerable expense, and during the repairs I rigged a "crab" on the shore end of the draw, and worked the draw by hand. I have now placed a portable steam-engine on the end of the draw-pier or draw-rest, and provided it with cables for use in case of accidents. This method of operating the draw temporarily would be satisfactory were it not necessary to stretch the cables across one opening or span of the draw. An animosity exists between river-men and bridges, which tempts the former to select the opening where the cables are, and to run their vessels into the cables and cut and break them. It is better than the slow moving of the draw by hand-power. Another defect in the machinery is that no brake is provided for stopping the draw. It is now stopped by putting pressure on the jack opposite to the one that creates the motion. In high winds this pressure is likely to exceed the strength of the machinery. It will be understood that, unless the draw is operated promptly, either the use of the bridge by the railroad company and the public or the river for navigation must stop. When any interruption occurs unjust and thoughtless reports are likely to appear in the newspapers. I have therefore deemed it advisable to make this report, that the Department may be in possession of the facts in the case. I will, as soon as practicable, endeavor to prepare and submit plans for remedying the defects mentioned.

ROADS, GROUNDS, RAILROADS, GRADING, ETC.

This work has been, mainly: The building of the arsenal railroad; the grading and building of Fort Armstrong avenue; the grading of Rock Island avenue, nearly completed; the grading of Main avenue from West avenue to the west end of the island, one mile, nearly completed, and piking a portion of the same; the grading and building of East avenue from the north side of the island to South avenue; the completion of the portion of West avenue along the west side of Shop B; the completion of the portion of Main avenue along the front of Shop B; grading of grounds at the west end of the island; grading of grounds in front of Shop C.

Arsenal railroad.—This has been built in accordance with the plans submitted to you and approved. The total length of the road is 7,264 feet, 1½ miles nearly, and of

switch, 1,490 feet long. The road-bed required a heavy filling, 37½ feet high, at the switch, where it connects with the track of the Chicago, Rock Island and Pacific Railroad, in Sylvan Water, and the fill continued to a point 2,700 feet from the switch. The total amount of filling made was 11,000 cubic yards. The total amount of cutting was 3,386 yards. The "cutting" could not be used in the "filling" economically on account of the length of haul. The road is permanently and well built, and has only one curve, that at the switch, with a radius of 600 feet, and no grade greater than 10¾ feet per mile. As the change of plans to get a good and permanent construction of both the railroad and avenues at the west end of the island was made after the estimate for the work was made, and the appropriation was insufficient, and the work was absolutely necessary for the transportation of stone and material for buildings, a portion of its cost had to be charged to the buildings for which the material was transported.

Fort Armstrong avenue.—This avenue connects the bridge to Rock Island with the bridge to Davenport, and is for the accommodation of the public who cross the bridges between those cities. It is 1,046 feet long. It is piked with finely-broken rock 12 inches deep, and covered with gravel to a width of 50 feet. A considerable cutting through rock was required for this avenue.

Rock Island avenue.—For Rock Island avenue there was required a "cutting" of 16,880 cubic yards. This was used in "filling" for the railroad, and for grading low ground near the arsenal store-house and the west end of the island.

Main avenue.—The grading of the new part of Main avenue, from West avenue to the west end of the island, has been nearly completed. In this work "cuttings" of 5,492 cubic yards and "fillings" of 14,973 cubic yards were made.

Remarks.—Some difficulties have been encountered in maintaining the regulations for the control of the public wagon-road across the Rock Island bridge and the west end of the island. These difficulties are principally those apprehended in my letters to the Chief of Ordnance dated October 1, 1872, and December 2, 1872, and the expense of the maintenance of a sufficient guard to enforce the regulations. The difficulty lies in the fact that force is generally the means that must be used to maintain order on the bridges, and the employment of force requires great care in avoidance of dissatisfaction on the part of the people, and danger to the officer using it of rendering himself liable to prosecution. Evil-disposed persons soon obtain knowledge of this. A careful use of the rule of excluding persons who wantonly break the regulations from the use of the bridge will, I believe, be generally sufficient. Some cases have occurred in which the cities have tried to contest the jurisdiction of the United States and the United States courts over the bridges. These cases are unimportant and easily controlled, except inasmuch as the controversy relates to the Davenport bridge approach, and that portion of the bridge between the center of the main channel and the Davenport shore. Unfortunately the bridge was built without any cession of the land occupied at the Davenport end. A case is now being tried in the United States courts involving this question. I will make a full report of the case in connection with a report upon the bridge. I believe legislative action by the State may be required in the matter.

The completion of the Moline bridge leads the people to covet the use of the arsenal as a highway between Moline and the cities of Rock Island and Davenport, the arsenal roads being generally pleasanter than the highway down the Illinois shore and the route across the Rock Island bridge to Davenport. I fear that this question will always be a source of some trouble to the Department. At present the influential and thinking people of the community are earnest in their efforts to prevent any attempts to get such a privilege, and only occasional dissatisfaction occurs.

I respectfully invite the earnest attention of the Department to the effect upon the operations of this arsenal of the law of July 12, 1870, covering unexpended appropriations into the Treasury.

In building, an appropriation generally is only sufficient for the operation in hand, and the effect of the law is then simply to compel the forced completion of the operation within the year. This enforced completion is difficult of accomplishment, and must always be attended with imperfections in the work and considerable additional expense and loss of money. For instance, an appropriation is made for the erection of a building. The money is not available for the work until after July 1st, and cannot be obtained till some time thereafter, and the building must be completed before the 30th of June following. For most buildings the walls must be completed and the roof put on before cold weather, so that interior work may go on during the winter, or the building cannot be completed within the year. Under the laws and rules governing expenditures, work cannot be well under way until the latter part of July. There is then left of good weather only August, September, October, and sometimes a part of November, for all the excavation for foundations and basements, (generally in rock, a slow and tedious work, requiring blasting,) and for the completion of the walls and roof. The walls are stone, and stone-work involving architecture cannot be hurried satisfactorily. All the operations of getting suitable stone from distant quarries,

transportation, cutting, and preparation for the walls are slow, tedious, and troublesome, and delays are sure to occur.

I believe that any architect would deem it nearly impossible that the walls of the barracks at this arsenal could have been forced to completion in the short time in which that work was accomplished last fall. The elements of loss in doing work in this manner are as follows: Suitable material cannot be obtained, and high prices must be paid; a quarryman cannot work his quarry to advantage, and must charge accordingly; the contractor at once understands his advantage, and the tendency is to deliver poor material; the officer must sometimes accept material which he would reject, were not the alternative the loss of his appropriation and failure to do his work. Again, a large force must be employed on the work. This involves the payment of extraordinary wages to get workmen to pay traveling-expenses and change their abode, when they must be discharged in a few months. Troublesome workmen find out that the Government is in their power, and the system induces strikes. This necessary employment of a large force temporarily, and then a suspension of work, and requiring workmen to lie idle, not only creates great dissatisfaction among workmen and in the community, but also deprives the Government of the advantage of giving workmen regular and permanent employment, whereby they are induced to make this a permanent home, and their services can be obtained at fair, low wages. It is impossible in most cases to push walls to completion before cold weather, and the upper and difficult part of the wall must be built in the extreme cold of winter at great loss. The season for advantageous work commences in the spring and closes in the fall. The close of the fiscal year comes just in the middle of that season, and work must gradually stop as the end of the year approaches. This occurring in the busiest part of the season, many of the best workmen are sure to get employment elsewhere before work can be resumed. Little latitude is allowed in making purchases, and they must be made at once, no matter what is the state of the market, and without waiting to order from distant sources.

The foregoing are only a few of the evils of the system. Great trouble and labor are involved in combating them, and it cannot always be done successfully. I know of few things so disheartening as to labor diligently and well to accomplish work economically and find oneself defeated unnecessarily. The evils spoken of have been in full force at the arsenal during the past year. The rebuilding of Chicago drew off every kind of material and labor required at the arsenal, promoted strikes, and advanced prices, and, being forced to accomplish work within a specified time, it was impossible to do it well at satisfactory prices and keep within estimates. I believe that none of these facts are new to the Department. If the Department deem it practicable to get from Congress any modification of the law, I respectfully urge the great advantage to this arsenal of such a modification as will make appropriations for public buildings at this arsenal permanent appropriations, or available for three years instead of one, and I respectfully request that some action to this end may be taken.

Report of Lieut. Charles Shaler, Ordnance Department, upon the ice-gorge and breaking of the dam between Rock Island and Benham's Island in March, 1873, referred to in the foregoing annual report.

March 11th.—The ice, which is very thick, has been acted upon by the sun to such an extent as to weaken it very much. The snows have been deeper and more frequent than is usual in this region, and their melting has caused water to run over the surface of the ice in the river and on the small streams. The ice on Duck Creek and a stream called the Wapsipinnicon, above here, has yielded and is reported to have run out into the river.

March 12th.—The ice on Rock River has passed out from the dam at Milan to the mouth. To-day the opening which has existed for some months past opposite Benham's Island was closed by ice which broke away from above. Ice opposite Winnebago Island has not yet yielded. During the day ice has continued to break away from above, so that there is clear water visible from opposite the lumber-mills in Moline to the bend above. Ice which has floated down has been gorged opposite Benham's Island, and is piled high on the East Davenport shore and the wing-dam. Another gorge has commenced to form opposite Winnebago Island. The ice lying in the pool has been forced down a few feet by that in the main channel. It is still quite strong and has broken the props which sustained the first bridge between the island and Benham's Island. The coffer and stone beneath the bridge have been carried away for some 30 feet. The water is pouring through with great violence.

March 13th.—Gorge opposite Benham's Island broke, and, followed by floating fields, was driven against the gorge at Winnebago Island, forcing this mass down opposite the pump-house. From the middle of the river to the Davenport shore, the gorge seems to be on the ground, but from the middle to the island shore the water finds a passage. The covering over the filter at pump-house is injured. The island bank is covered with large layers of ice, superimposed so that there are piles 15 feet high. The

water is rising rapidly. By evening the water is flowing from the river through the culvert just above the upper barn, and is covering the low grounds. A party was sent up this morning to remove the plank and timbers from the broken bridge, in order to save the materials.

March 14th.—Water still rising above the gorge, and pouring through the upper part of the Moline bulk-head (which is generally above the water-line) in such quantities as to make a loud roaring. On the river road water stands 12 inches above the culvert. All the material that could be reached has been removed from the bridge. The water is still rising, but not so rapidly as yesterday. Large fields of ice come down from above and pile up on the gorged ice and on the shores. By night the ice fills the channel up to the bend above.

March 15th.—Condition of gorge unchanged this morning. Water still rising gradually. About 1 o'clock the gorge broke and moved slowly but continuously. The whole river as far as the bridge is covered with moving ice. At the foot of the island it is apparent that the ice between the cities of Rock Island and Davenport has not changed its position. The mass moving under the bridge is forced up on the banks opposite Main street, in the latter city, and a great portion of it is pushing directly south toward Illinois shore. Before reaching the shore it turns east and runs up Sylvan Water, being forced violently against the west side of causeway and piers of Rock Island bridge. It continues to pass in this way, without escaping below, for an hour. The water is now rising very rapidly. After this the ice begins to move opposite Main street, and as far as can be seen below it is in motion. The water is falling rapidly. The broken masses of ice which have passed above the Rock Island bridge into Sylvan Water return with great violence, breaking two of the telegraph-poles which stand above the piers. Until night the ice passes rapidly but quickly, filling the channel from shore to shore. The water has passed out from the low grounds near the barn to the river.

April 5th.—The work of closing the break made by ice in the Benham's Island dam commenced to-day. Twelve men, under a foreman, are quarrying stone from the bank near the guard-house to fill the cribs. Plank, nails, and tools were sent yesterday afternoon. A foreman and two carpenters are sawing out plank to lengths of 8 feet. The cribs are to be built cob-house fashion, with ¾-inch iron bolts at each corner, and large spikes passing through each layer of plank. A flooring of plank is to be placed on the first layer to retain the stone. A large timber is to be floated, with one end resting against the island side of the breach. The crib, being floated and suitably fastened to bolts on the shore, will be allowed to swing against the timber. When the rope which holds the crib is paid out, it will float against the timber, which serves two purposes, viz, to guide the crib to its position in the opening, and to keep it off the shore, where otherwise it would be forced by the violent current. A large post is sunk in the crest of the bank two hundred yards above the breach. A watch-tackle is arranged, with one block attached to a ring-bolt, and the other to a wire rope. The running rope of the tackle is passed twice around the post to check the crib. To the outside, up-stream corner is fastened the wire rope already mentioned; to the other up-stream corner is attached a ¾-inch hemp rope, passed through a ring-bolt at the water edge some 20 feet above the breach. The crib being finished, is to be launched, towed a little way into the current, when, by the slacking of the ropes which hold it, one side will impinge against the timber. The connecting ropes will be gradually paid out, the crib, sliding along the timber, be guided to its place, and, on reaching the end of the timber, swing suddenly into position. The ropes will now be made fast and the crib (being filled with stone) sinks to the bottom.

April 7th.—Crib launched about 2.30 p. m.; then was easily floated into place and sunk by night. The arrangement for manipulating the crib proves to be so strong as to allow a much longer one to be handled. Orders are therefore given to make the next one of 12-inch timbers, 12 feet long. The construction and method of swinging into place are the same. In order to fill with stone, another large timber is floated in beside the first, pieces of board nailed to them to separate them, and plank laid on them for a wheel-way.

April 8th.—Worked in the morning. Rain and snow in the afternoon stopped the work.

April 9th.—Work interfered with by rain. In afternoon another crib was floated into place. The timber which acts as a guide has its upper end resting on the shore; its lower end rests against the outside corner of first crib.

April 10th.—Another crib built, floated, sunk, and filled. It was necessary to work till 6 o'clock to get all the rock in.

April 11th.—The fourth crib placed in position and filled.

April 12th.—The fifth and last crib was made 8 feet, because the opening had been so much reduced as not to admit a larger one. As a good deal of plank was on hand already sawed and bored, it was used instead of larger material. The last crib was floated into place and partially sunk before 12 o'clock. In the afternoon the filling was completed. An opening of some 4 feet still remained; this was closed by forcing

down plank which abutted against the last crib and the dam; large stone were then rolled in until the force of the current was effectually broken.

April 14th.—A force of eight men is at work, under a foreman, quarrying stone, which is wheeled out on a raft and dumped in front of the cribs.

April 15th.—Stone-wheeling goes on. The material is now dumped from the cribs and is allowed to take its natural slope. By night the dumping is finished. The stone in front of the crib reaches all the way across from the shore to the end of the old dam, rises (having its natural slope) one foot above the cribs, and the cribs themselves are covered all the way across one foot deep. Heavy stones have been put on top of all for ballast.

April 16th.—Work has received its final inspection by the commanding officer, and is approved by him. Directions are given by him to allow it to remain as it is till further orders.

Respectfully submitted.

CHARLES SHALER, JR.,
2d Lieut. of Ordnance.

C.

Annual report of the principal operations at the Rock Island arsenal, Ill., during the fiscal year ending June 30th, 1874.

SHOPS.

Shop D.—During the year the walls of this shop have been entirely completed; about one-half of the window-sash and window-frames have been completed; the wrought-iron columns for supporting the second and third floors have been purchased; the iron-work for the second and third floors all put up, and the work of grading around the shop, building area-walls, steps, platforms, and sewers, and putting in water-pipes has been commenced. All of the fitting and finishing of the iron-work for floors was done in the arsenal shops, and the manufacture of all the windows, doors, and other wood-work is done in the arsenal shops.

Very serious trouble has been encountered in procuring from the contractor the stone required for the completion of this shop. The last stone required for a shop is the entablature, and this is all costly dimension-stone, for which the contractor has a ready sale at high prices in Chicago and other cities. Under the contract all the stone for the shop was furnished at one price, this price being the average value per yard of all the stone taken together. On this account the contractor has experienced a difficulty in furnishing this stone. After vexatious and expensive delays I was forced to purchase a portion of stone in open market, and charge the purchase cost to the contractor, as provided for in the contract. I have taken much pains and trouble to avoid making these purchases and to make the purchases as small as possible when they could not be avoided, and to prevent any loss to the contractor when they were made. I feel confident that in these purchases of stone for this shop the contractor has not suffered a loss. Nevertheless the contractor has protested against the purchase, and I have had difficulty in settling up and closing the contract for stone for this building. I have to add that the procurement of stone from quarries other than the contractor's which may be used advantageously in a building in this way is difficult and requires much pains and trouble.

Under the laws governing appropriations, it was imperative that the walls be finished within the year; and as I could not procure the stone from the contractor, I was forced to make purchases as provided for in the contract.

This report is made because it is possible that the contractor may hereafter make claim against the Government for losses.

This shop is marked "D" in the accompanying map.

Shop A.—The work done on this shop during the year has been, mainly: The tearing down and removal of the old temporary shops and machinery which occupied the site of this shop; the excavations for foundations, excavations for basement-story, and excavations for court between the two wings; the building of the foundations, basement-story, part of first story, and stone piers for the support of the first floor; the building of a portion of the sewers, putting in water-pipes, and the repairs and construction of derricks, derrick-tracks, and other machinery for use in construction; the purchase, fitting, and putting up of the iron-work for the first floor, and the purchase and fitting of a portion of the iron of the second floor, and the purchase and stacking for seasoning of 310,559 feet of pine lumber and 185,991 feet of oak lumber.

The total excavations for this building were 91,460 cubic feet of earth and 148,867 cubic feet of rock.

No very serious difficulties were encountered in getting foundations for this shop,

though for a part of the building the excavations were 15 feet deep. All the foundations are excellent, being on good bed-rock.

The cast-iron caps and bases for columns have been purchased for the other shops at an average cost of $27 each for first floor and of $20 each for second floor. These are the lowest prices paid. I have cast and fitted in the arsenal shops caps and bases for this shop, at a cost of $10.36 each for first floor and $9.40 each for the second floor, making a total saving on the two floors for this one item of $2,074.24, not charging for the scrap metal used.

SHOP-FIXTURES.

All of the appropriation for this purpose has been expended in fitting up Shop C for immediate use as a carpenter and machine shop. This work was begun in the preceding year, but as it was unfinished, it was not reported in my last annual report.

The work has been mainly the putting in of a battery of four steam-boilers with capacity sufficient for 230 horse-power; the putting up of one Corliss engine of 125 horse-power; the building of the engine-room, shop-offices, and store-rooms; the putting up of two main lines of shafting, each 300 feet long, with the necessary countershafting; the putting in of necessary water-closets, wash-rooms, and steam and hot-air lumber-drying rooms in the basement.

The boilers and iron for shafting were purchased, and the engine was received from the Springfield armory. Nearly everything else required for fitting up the shops was manufactured in the arsenal shops.

The following list of drawings explanatory of this work is transmitted herewith:

Drawing: Plan of first floor of Shop C with boiler-house and chimney, showing position of offices, engine-room, steam-engine and pipe, shafting with main belting, and of work-benches with cupboards.

Drawing: Plan of belting from engine to shafting in Shop C.

Drawing: Plan of shafting for machine-shop wing in Shop C.

Drawing: Plan of main line of shafting in wood-working wing, Shop C.

Drawing: Bolsters and stringers for Shop C, showing mode of fastening.

Drawing: Plan and section of boiler-foundations, showing underground flue, and part of chimney in court of Shop C.

Drawing: General plan of boilers, Shop C.

Drawing: Elevation of boiler-front.

Drawing: Plan and elevation of working-bench and cupboard in Shop C.

Drawing: Coupling, hanger, and box.

The method of fastening shafting-hangers to the iron beams of a fire-proof floor (shown in Drawing C 5) works well. It is effectual and economical. This method is new and was devised here.

The hanger, coupling, and box are shown on Drawing C. The coupling and box and parts of the hanger are new and were devised here. The coupling possesses particular merit, especially that of economy, and was devised by Mr. J. P. Stevenson, master-machinist. The box has in it a system of grooves which lead surplus lubricating-oil through a §-inch diameter hole into an ornamental cast-iron drip-vessel attached to the bottom of the hanger. The grooves are packed with wool, which acts as a self-oiler. The boxes require oiling about once in four days, and the feed of oil from the wool is generally just sufficient. There is no ooze of oil from the box upon the shaft. This box is found to be very satisfactory.

On account of the great amount of work-bench which must be built hereafter, considerable attention was paid to the subject. The construction and arrangement are shown in drawing.

A good deal of attention and study was bestowed upon the plans for setting the boilers, flues, &c., as shown on drawings.

The boiler-house room is a handsome one, and it was desirable to get as handsome a boiler-front as possible. The appearance of the front is greatly improved by the avoidance of breaching and sheet-iron smoke-pipes. The smoke-flues are all under ground. This arrangement is mainly important in the saving of fuel, there being no radiation of heat from the flues. The radiation of heat from all the boilers, front and flues, or waste heat, is barely sufficient to keep frost out of the boiler-room in cold weather.

So much attention and study have been devoted to the fixtures for this shop because the work being done in our own shops it is desirable that the expense of new patterns for castings, the labor of devising and making new plans and drawings for the same work in other shops may be avoided, and that the work may be as uniform as possible in all the shops. On this account, also, full and complete drawings have been made and preserved for future use. The working of all these fixtures has thus far been entirely satisfactory.

SHOP E.

Besides some finishing-work on this shop, blacksmiths' forges and a foundery have been put in the shop, as shown in the following drawings transmitted herewith:

Drawing: Plan of Shop E, showing position of line of shafting, crane, cupola, melting-furnaces, casting-pit, core-oven, brass-foundery, smiths' forges, smoke-stack, and machinery.

Drawing: General plan of blast-pipes, Shop E.

Drawing: Plan of core-oven and brass-furnace.

Drawing: Plan of hanger, bracket-hanger, Shop E.

Drawing: Plan of cupolas in foundery, Shop E.

Only 14 forges have been erected for immediate use, it being deemed advisable to leave the other forges to be erected to suit the future wants of the arsenal, as operations of this kind are subject to changes. All of the smoke-flues for these forges are underground and lead to the chimney-stack, 65 feet high. The draught of this chimney has thus far proved sufficient for the smiths' fires without the use of an exhaust-fan. This construction is merely experimental and its success is important. By it are avoided the great expense of numerous chimneys high enough to pierce the roof, the injury to the roof and destruction of the architecture, both exterior and interior, of probably the finest blacksmith-shop in the world.

The foundery.—The success and great economy effected in the use of the small cupola-furnace, erected in the old temporary blacksmith-shop, have determined the construction of a foundery, with greatly-increased capacity and facilities, in the new shop. A full plan of the foundery is shown on drawing. A single charge for the small furnace is 2,600 pounds, and for the large furnace, 6,500 pounds. By using a pool or large ladles, a single casting weighing 11,000 pounds can be made. It is found that, for economical work, it is better to have the two furnaces than one large one, so that the small or large one, or both, may be used at one time, to suit varying job-work. Also, in this way I was able to construct the furnaces from two unserviceable steam-boilers, which were on hand.

The saving in cost of work, by making our own castings at this arsenal, has been very considerable, and has caused a gradual increase in the amount of work. Castings are not made unless the saving will pay for the patterns and flasks, so that a valuable stock of patterns is accumulating; and, besides these, I am making a further saving of money and getting better work than can be obtained from private founderies in the West.

The following are computed savings on a few items:

The weight of cast-iron caps and bases (for columns) for one shop is 108,300 pounds. The lowest cost for one shop, when bought, has been $4,332. I have manufactured them for $2,682, or, not charging for scrap-iron used, the cost has been only $1,599.20, making a saving, in the last case, of $2,733.

The lowest cost of columns for one shop, when bought, is $12,312. I have already manufactured a few of those required for Shop A. From this I estimate the total cost of manufacture for one shop (charging one cent per pound for scrap) to be $6,200. Not charging the scrap, the cost would be $3,540, making a saving, for this item, of $8,772.

The weight of shop-fixtures cast for Shops C and E is 34,000 pounds. I believe these could not have been bought at the East at less than 10 cents per pound, and would have cost, delivered here, 11 cents per pound. These have been made here at a cost of 7 cents, including value of scrap used. On most other cheaper castings, which comprise the great bulk of the foundery-work, the saving has been 2 cents per pound.

Brass-foundery.—In the brass-foundery I am now making, from the expanding metal taken from obsolete rifle-projectiles, the hinges, bolts, window-hangings, and other house-hardware for the shops. This work was commenced because suitable hinges and window-fastenings could not be bought of sufficiently good quality. Finding a considerable saving in cost, the work has extended. The principal value of this work is, however, the procurement of much better work and adapted to a special use.

A somewhat extended report of the operations and advantages of the foundery has been made, because its construction and use when started was experimental, as far as the Ordnance Department is concerned.

The shafting in the foundery and smith-shop is driven by a wire-rope running from the main line of shafting in Shop C.

POST BUILDING FOR MAIN GUARD-HOUSE, FIRE-ENGINE HOUSE, AND QUARTERMASTER'S AND COMMISSARY'S STORE-HOUSE AND OFFICES.

This building has been completed in accordance with the approved plans and drawings. (See drawings marked "R. I. A., Nos. 381 and 382," on file in the Ordnance Office.)

This building is marked "C" on accompanying map.

SUBALTERN OFFICERS' QUARTERS NO. 3.

This building has been completed in accordance with the approved plans and drawings, (see drawings marked "R. I. A., No. 398," on file in Ordnance Office,) except the cornice. The specifications require that this should be of galvanized iron. During

my absence from my station in October the officer left in charge had constructed a wooden cornice similar to that on the other officers' quarters adjacent to th s building. As this cornice was made, it was deemed best, on account of economy, to use it.

MACHINERY FOR THE TRANSMISSION OF POWER.

This machinery has been constructed in accordance with the approved plans as far as the appropriation therefor would admit. The materials for the work have all been purchased, and the work of construction, so far as it has progressed, has been done in the arsenal shops.

PAVING OF THE BASEMENTS OF SHOPS B AND C.

This work has been completed. Drawing R shows a plan of these basements. The part which is colored brown is a roadway for wagons, giving access to all parts of the basement and to six elevator-hatchways for hoisting to the upper stories. This is paved with asphaltum concrete. The remainder is paved with flag-stones not less than 4 inches thick, and laid in courses, as shown on the drawing. There are 5 inches of sand under the flagging to prevent upheaval by frost. The basement is thoroughly drained, and has a complete system of sewers for carrying off waste water or other liquids used in manufacture. Cross-timbers 100 feet apart are laid in the asphaltum, that may be taken up in case it becomes necessary to cross the roadway with water or other pipes.

IMPROVEMENT OF GROUNDS, BUILDING OF ROADS, AVENUES, ETC.

This work has been principally—

1. The grading and macadamizing of Main avenue from *a* to *b*. (See accompanying map.)*

2. The grading of the remainder of Main avenue, of Rock Island avenue, and the hauling of rock for macadam upon portion of the same.

(The macadam for Main avenue has not generally been completed to the full width, and no sidewalks have been built.)

3. The completion of East avenue between c and *d*.

4. The partial grading of West avenue from *e* to *f*. This work has consisted of the hauling in of about 45,000 cubic yards of rock and earth, obtained from the excavation for Shop A.

5. The grading and macadamizing of Second street between Main and South avenues.

6. The grading and macadamizing of the court of Shop E, and of all the space between Shops E and C and the railroad-track.

7. A considerable amount of work has been done on the road *g h* in front of the officers' quarters. The grading and macadamizing of First street between Main avenue, North avenue, and the court of Shop D had been commenced, some new railroad-sidings laid, and 1,800 feet of flag-stone sidewalk on First street, Second street, West avenue, and along the road *g h* in front of the officers' quarters has been laid. The macadam spoken of herein consists of 1 foot of finely-broken rock covered with 6 inches of gravel. These roads are expensive, but are thoroughly constructed, and durable.

ROCK ISLAND BRIDGE.

Some trouble and annoyance have been encountered during the year in maintaining government on the bridges, but no serious disturbance has arisen. Some trouble and resistance to the enforcement of the regulations for the bridge seem inseparable from its use by the public, when there is no legal penalty for violation of the regulations. These troubles have generally arisen from fast driving, racing, and conflicts with disorderly and drunken men. In such cases the penalty of excluding such persons from the use of the bridge has been sparingly used.

I quote the following from a report of the foreman in charge of the bridge on this subject:

"The offenses against the regulations for the government of the uses of the bridges by the public are of all kinds and numerous—fast driving and drunkenness being the principal ones. Many persons have been deprived the use of the bridges for the above and other offenses, but after a promise of better behavior the privilege has, in most cases, been restored. On Sundays the drinking-saloons of Rock Island are closed, while those of Davenport are kept open as on other days. This takes the worst class of people from the former to the latter city on that day. Most of those seeking to return in the evening are more or less intoxicated, making the duties of the guards particularly hard in trying to preserve order. I would respectfully recommend a special bridge patrol for Sunday afternoon and evening."

No decision in the courts founded upon the case reported in my last annual report has yet been arrived at respecting the jurisdiction of the United States courts over the part of the bridge between the channel of the river and the Iowa shore.

* Map referred to is not included in this book.

The following statement is condensed from the records kept at the bridge during the year:

The whole number of cars crossing the bridge during the year was 128,930 freight-cars, 8,630 passenger-cars, and 2,772 engines without cars; making a total of 140,332.

The number of steamboat trips through the bridge was 2,139, of barges 521, and of rafts 626.

*The number of teams passing over the bridge during the year was 228,000.

*The number of foot-passengers, 408,000; and the estimated number of passengers in vehicles was about 400,000.

The mean stage of water was 5.22 feet, being the highest March 10, 1874, 14.90 feet, and the lowest December 2, 1873, 0.80 feet. Navigation was suspended for steamboats from November 17, 1873, to March 16, 1874, on account of ice. Navigation was suspended at one time 12 hours, at another time 20 hours, because it was unsafe to open the draw during gales of wind.

During the year fifteen rafts were more or less broken by striking the bridge-piers.

On July 8th, 1873, the machinery for operating the draw was completely disabled by the breaking of one of the hydraulic cylinders and of the receiving-tank for the pumps. From this time until they could be repaired the draw was operated by hand-power, by means of crabs and ropes. This plan made it necessary to have a rope across the south channel when the draw was open, and was the cause of much vexation, as boats sometimes insisted on using this channel, making it necessary to cut the rope, and causing considerable work and delay in closing.

The repairs of the machinery included some alterations and additions. Among other things, safety-valves were placed on the pumps, so as to avoid an excess of strain on the cylinders.

A portable cylinder was placed on the upper rest for draw, to operate the crabs in case of necessity; but since the alterations above named we have had no breakage, and consequently have had no use for the portable engine.

All of the machinery is too light for operating the draw in windy weather. Some changes will be made in this machinery during the coming winter, and checks, or buffers, for stopping the draw in a high wind will be added.

It is probable that, on account of the difficulty of procuring appropriations for the care and preservation of the bridge, particularly for renewing the plank roadways of the bridge; for the repairs and renewing of paving of Fort Armstrong avenue, rendered necessary by the wear of the same, consequent upon the use of the bridges by the adjacent cities; and the cost of maintaining a sufficient guard and police to maintain order on the bridges, it will become necessary, eventually, to charge a small toll.

I append hereto a copy of a letter, marked "C," reporting a strike of the stone-cutters employed at the arsenal, which occurred June 23d, 1874.

Information obtained subsequent to the date of this letter convinces me that the strike was partly caused and principally maintained by persons opposed to the present administration, who were endeavoring to use the workmen for political purposes. The strike lasted so long that workmen from other places were finally invited to come here for employment. Considerable resistance to the employment of these men was offered, but 23 of them were employed; and when the old workmen returned and asked for work, all of them could not be employed immediately, but work would be given them as soon as vacancies occurred. Also 8 men, who had been particularly troublesome, or had acted as *ringleaders*, were informed that they could not be employed again at the arsenal. The striking stone-cutters resumed work at the reduced wages peaceably on the 6th of July, 1874, and have been working with apparent contentment ever since.

I would again respectfully call the attention of the Department to the necessity to this arsenal for some relief from the operation of the law requiring that unexpended portions of appropriations be covered into the Treasury at the close of the year. The bad working of the law, particularly as regards economy, during the past year, has been somewhat disheartening.

C.

ROCK ISLAND ARSENAL, ILLS.,
June 26, 1874.

CHIEF OF ORDNANCE,
U. S. Army, Washington, D. C.:

SIR: I have the honor to report for your information that a "strike" of all the stone-cutters employed at this arsenal occurred on the 23d inst., and that the strike still continues. All of the cutters have requested their discharge, and have been paid off. Many of them wish to return to their work, but say they are afraid to do so. The

*This estimate is made from records kept one-half the time.

reasons given by the workmen for the "strike" are a reduction of wages from $4 to $3 per diem, and they are forced to work much harder here than elsewhere.

Three dollars per diem are the highest wages paid to cutters on the construction of the custom-houses in Chicago and St. Louis, are generally higher wages than are paid by private parties in those cities and throughout the Northwest; the wages in the latter case being generally from $2.50 to $2.75. But such parties do not generally get the very best workmen. The "strike" has been partly effected by the evil influence of a few turbulent men, but more through inflammatory articles in one of the newspapers issued in Rock Island.

There are so many stone-cutters out of employment in Chicago that I think new men can be employed within a few weeks; but as many of the cutters who have stopped work are very excellent and old and faithful workmen at the arsenal, and have been led into their present position by the evil influences of others, and would suffer great loss if deprived of work permanently, I desire to wait a few days to see if they will not resume work.

In view of the very hot weather, and the not very large amount of stone-work required to be done under the appropriations this season, I do not think this temporary suspension of work will cause any loss. I have, however, this day written for authority to have an advertisement for cutters published in a few papers if it should become necessary.

Very respty., your obt. servt.,

D. W. FLAGLER,
Captain of Ordnance, Bvt. Lt. Col. U. S. A., Comdg.

D.

Annual report of the principal operations at the Rock Island arsenal, Illinois, for the fiscal year ending June 30, 1875.

SHOP D.

This shop has been completed during the year. The principal work done was as follows: The manufacture and erection of the iron roof-frame; the manufacture and putting in the wood-work; the roofing, with slate and copper; the putting in of the fire-proof arches; the building of stone area-walls and steps; the grading and paving around the building and in the court, and putting in water-pipes, sewers, and sewer-pipes in the basement, and painting.

The iron roof-frame for this building is the first one that has been manufactured at the arsenal. Heretofore this work has been done at the East by iron-bridge-building establishments. With the facilities for work afforded by the new smith-shop (E) at the arsenal, there seemed no good reason why this work should not be done here.

The advantages obtained by doing the work here have been—

1st. A small saving of cost in the work.

2d. A probable larger saving in cost of the iron, by admitting to bid upon it a large number of iron-manufacturers who could not manufacture the roof, and were therefore excluded from bidding under the old system, leaving the manufacture of the roof to a small ring.

3d. The work is probably better done.

4th. We have been able to supply the roof more nearly at the time when it was required.

These advantages are sufficient to warrant the manufacturing at the arsenal of the roofs that will be required hereafter.

All of the doors, windows, and other wood-work, and all of the house-hardware for the same, were manufactured in the arsenal shops. Nearly all of the last was cast from expanding metal taken from condemned projectiles. This work began on window-hangings, because hangings of sufficiently good quality could not be purchased, and finding that a considerable saving of cost was effected thereby, I have extended the manufacture to other house-hardware.

The slating and copper-work were done by contract.

The brick arches have heretofore been put in by contract. In this shop they were put in by day-work. The work is better done, and $1,785 saving in cost of the work was effected. This part of the work was mainly in charge of Lieut. E. M. Wright, Ordnance Department, and the saving of cost is largely due to his energy, ingenuity, and application.

SHOP A.

The work done on this building during the year has been the building of the masonry of a portion of the first story above the basement, and all of the second and third stories; the purchase, fitting, and putting up of all of the iron-work of the second and third floors, and the manufacture of a portion of the wood-work. A portion of the

iron-work referred to is the columns which support the second and third floors. These have heretofore been purchased, but for this shop they were manufactured here. The saving of cost on the columns was $7,472, after charging one-half cent per pound for the scrap-iron used. Drawings of the columns are inclosed herewith.

SHOP F.

The work done on this shop during the year has been the excavation for the shop and foundation; the building of the foundations, and walls to include the water-table, and the purchase of the lumber and a portion of the stone required for the building.

Such delays occurred in getting approved the contracts for stone for this building as to prevent the procurement of any considerable supply of stone last fall, and as the quarries opened late this spring, not much stone could be prepared for the walls before the close of the fiscal year.

With the approval of the Chief of Ordnance, a considerable change from the plan of the other shops is made to widen the doors of this shop. This change is deemed necessary, as the wide doors will probably be required in case heavy guns should be manufactured or other heavy work should ever be done in this shop. (See Drawing B.)

FOUNDATIONS OF SHOP F.

I have prepared very carefully a geological chart of the foundations of this building, and of materials excavated in getting foundations.

I regret that for a portion of this building a perfectly satisfactory foundation could not be obtained. For Shops A, D, and E, I have obtained good rock foundations, though sometimes with great difficulty and expense. For a portion of the foundation of Shop F rock could not be obtained. The portion referred to is most clearly shown on the plat of the foundation on the drawing, (C.) This portion of the foundation is a strong, black, indurated clay. I excavated generally about 3 feet of this clay. The excavation then became so difficult that it appeared necessary to abandon it. Little could be done with the pick and nothing with the blast. I examined the clay in places about 10 feet deeper. After going down 3 feet of this 10 a small steel drill could be driven into the clay only with great difficulty. The clay was wet, tough, strong, very compact, and when taken out and dried, it was like slate. It was perfectly uniform and resisted the action of water. I then made experiments to determine its compressibility. It will be remembered that this building is to be a rolling-mill, and has no floors. The foundations have then only to support the weight of the walls and roof. With a footing 6 feet wide this weight would be about 3,820 pounds per square foot under the pediments and less elsewhere. I placed a load of 4,000 pounds per square foot on the clay in places. No certain settlement could be observed in two days. I afterwards increased the load to 18,000 pounds per square foot, and in seven days the settlement was $\frac{1}{8}$ of an inch and uniform. This settlement was partly, if not mainly, due to pressing upward the uncovered clay around the loaded places. I then compressed numerous specimens in a tight iron box in the testing-machine, and obtained computed results for 10 feet of depth, showing a possible settlement of $\frac{1}{4}$ of an inch when loaded with 4,000 pounds per square foot and $1\frac{1}{4}$ inches when loaded with 20,000 pounds per square foot. These last experiments were unsatisfactory because of leakage of moisture and clay around the piston. Certainly the compressibility would be less than that obtained by the experiments. I then widened the footing of the walls to 7 feet and built on the clay 3 feet below its surface.

If the whole building stood on this clay, the foundation would be excellent, and entirely satisfactory, but a portion of it is on good solid rock. There will be no settlement of the rock foundation, and the experiments show a probable slight settlement of the clay foundation. The only objection to the foundation, then, would be a possible crack (some time in the future) of the wall over the juncture of the clay and rock foundation. To avoid this I am leaving gaps in the walls unbuilt over those points, to be put in after the walls are completed. This will leave two or more years for the clay foundations to settle before the gaps are closed up. It is certainly improbable that any crack will ever occur; but this full explanation, in connection with the chart, is given, in order that if it ever should occur, its causes may be fully understood, and apprehensions of the perfect security of walls removed. Numerous specimens of the clay have been labeled and preserved.

Considering the character of the building, and the probability that great steam-hammers may be used in it some time in the future, it is probable that the clay foundation would be best, if it were uniform throughout the building, because it would be freer from vibrations than the rock foundations.

At the present time eighteen months have passed since this report was written, and no settlement of these walls can be observed. (See annual report for year ending June 30th, 1876.)

WATER-POWER.

The work done on the water-power during the year has been (see Drawing D, inclosed herewith)* the excavation of the shore and bed of the river at A and B, to give room in the pool and tail-race; the building of an earth and riprap dike from *a* to *b* to prevent overflow from the pool on the island; the construction of an earth and riprap dike from *c* to *d* to prevent overflow from the pool on the Moline Water-Power Company's land; the completion of the rock dike *d e;* a portion of the work on penstocks and the pulley-house; and the completion of the gates and hoisting-machinery for same for the water-power dam, and putting up of the same.

Four large wash-gates, for openings 9 feet by 11 feet, have been constructed and put up with special machinery for hoisting. The object of these gates is, by opening them Saturday nights or when the power is not in use, to carry away flood-wood and wash out the pool and tail-race. To do this, the gates must be ope ed with the full pressure of the head of water against them. This pressure at high water will be 30,100 pounds. The construction of these gates and of the machines for raising and lowering them is shown on Drawings E and F. The gates are in sections, which telescope and slide out again in raising and lowering, so that only a portion of the pressure has to be overcome at one time. The heaviest computed lift that can occur, including weight of gate, and taking 0.45 for co-efficient of sliding friction, is 9,100 pounds.

The hoisting-machine is constructed to bear a strain of 50,000 pounds, and two men at the end of levers, 6 feet long, can lift 50,000 pounds. (Calculations for the machine are given in the drawings.)

RESERVOIR AND WATER-PIPE.

The work done on the reservoir during the year has been as follows: A roof has been put on; the walls repaired; a water-tight lining put inside the walls. The lining consists of an 8-inch brick wall, or, practically, two 4-inch brick walls, laid in Portland cement.

This work has been done with much care. First, the 4-inch brick wall next to the stone walls of the reservoir was laid, and the space between the brick and stone was filled by pouring in fluid cement mortar as the work progressed, thus forming a complete water-tight layer of cement between the two walls.

The inner 4-inch wall followed the other and was built in the same way, giving another complete water-tight layer of cement between the two brick walls.

These two brick walls cover in the same way the partition-wall in the reservoir. The floor was covered with one layer of brick laid in the same way, and the whole—floor and walls—then plastered with the Portland cement. This last, having a polished surface from the trowel, is the best water-tight layer.

The reservoir is now perfectly water-tight, and I hope it will remain so. The only danger I can foresee will be from the action of frost, to which the walls are always exposed. If a crack occurs in the plastering, and water gets behind the plastering, frost will heave it off. Water can then filter through the brick, and the action of the frost continues on the other layers of cement. The work, however, is well done, and I believe it will stand.

The floor of the reservoir has no foundation except earth, and there is some danger that it may be affected by frost, but outside the reservoir is banked with earth to above the floor-line for protection.

Some difficulties occurred in getting fresh imported cement, and in doing the work while water was maintained in the reservoir to supply the arsenal. This prevented its completion last fall and has given much trouble. A drawing of the completed reservoir, marked "G," is transmitted herewith.

WATER-PIPE.

There has been manufactured and laid during the year 1,760 feet of 8-inch main, completing the main for all the shops. This main runs from the reservoir along North avenue to Fourth street, along Fourth street from North avenue to South avenue, along South avenue from Fourth street to West avenue, along West avenue from South avenue to North avenue, along North avenue from West avenue to the reservoir again. (See Drawing K, transmitted herewith.)

A gate is put in the supply-main at *m* to cut off the reservoir, in order that the Holly pump at the water-power dam may put a high pressure on the main in case of fire.

The excavations of trenches for the pipe had to be 6 feet deep to be safe from frost, and were generally in rock, requiring blasting, and being near the shops, the work was difficult and expensive. The pipe was manufactured in the arsenal foundery.

FILTERING-CISTERNS.

It is proposed eventually to supply the reservoir with water from a large rotary pump near the water-power dam, to be driven by the water-power. To supply this

* Map referred to is not included in this book.

pump with water, I have taken advantage of the time while the coffer-dams were in and the bed of the river pumped dry to put in filtering-cisterns. I have taken some pains in devising plans for these, as they may be of some general value. A full description of them is given here.

Both the filtering-cisterns furnish filtered water to the center or water cistern, from which an 8-inch suction-pipe is laid. Over the floors of the filtering-cisterns is laid a system of open-drain-tiles. These are covered with coarsely-broken rock, then a layer of coarse gravel, then a layer of sand. The water gets into the filtering-cisterns through 3-inch-diameter openings in the top. The opening in the top of the water-cistern is generally closed and admits no water. It will be necessary at times to get to the filter beds to change the material. This should be done at low water only. The elevation drawing shows low water, and also two coffer-pipes (cast-iron) extending down to the openings in the filtering-cisterns. A similar coffer-pipe is provided for the openings in the water-cistern. The positions of these openings are carefully fixed by the intersections of lines marked on the shore. When the three coffer pipes are put on, the pump can exhaust the water in all three cisterns, and workmen enter through the coffer-pipes. Only about three inches of sand at the top of the sand-layer should be fouled by sediment. This can be raked under the openings, hoisted out, and new sand supplied when necessary.

The filter-beds are calculated to filter 5,000 gallons each per hour, and both will give in two hours the estimated maximum future consumption of the arsenal per day, 20,000.

Clogging of the filter-beds with sediment, or an increase of discharge from the pump in times of fires, (the capacity of the pump is 15,000 gallons per hour,) might prevent the filter-beds from giving enough water, endanger the cistern by producing a vacuum in them, or fail to give the pump enough water when most needed. To prevent this, a safety-valve is provided in the opening in the water-cistern. This valve will open when the pressure on it is 3 pounds per square inch.

GRADING OF GROUNDS, ROADS, REPAIRS OF BUILDINGS, ETC.

The work done under this head has been, mainly: The completion of Main avenue between West avenue and Rock Island bridge; the construction of Rock Island avenue; the grading of grounds and planting of trees between Rock Island avenue, Main avenue, and the Chicago, Rock Island and Pacific Railroad embankment, and construction of roads leading to and around Store-house A; the building of a fence along the east side of Rock Island avenue; the construction of main-entrance gates and small guard-house at entrance on Main avenue; the building of First street from Main avenue to North avenue; the building of a portion of West avenue from South avenue southward toward the river, and filling up the slough along this part of the avenue; the grading of grounds and planting of trees on a portion of the grounds between the officers' row of houses and the river; some necessary work on sewers, needed repairs of buildings, and the planting of trees at many places on the island; the building of a small pump-house on the bank of the river to replace one burned during the winter.

ROCK ISLAND BRIDGE.

In consequence of obscurity in the wording of the act of Congress making appropriation for work on the bridge, and the necessity for waiting until further action in the matter could be taken by Congress, I could not commence this work until this spring. The appropriation was made available March 19, 1875, and I at once began to prepare materials and commenced work on the bridge May 8th.

A complete new covering of sheet-copper has been put on the upper or railroad deck, with necessary gutters and down-spouts, and a covering of plank to protect the copper and serve for footwalks.

In explanation of the peculiar construction adopted for this covering, I have to say that in the original construction of the bridge too little head-room for engines and cars was left over the railroad-deck under the top cross-braces. No water-shed was originally given to the railroad-deck, and in consequence of the insufficient head-room the railroad-track could not be raised at all to get room for water-shed. The deck is supported by 15-inch iron beams framed into the main posts, so that it was impossible to *lower* the deck in order to get room for water-shed in that way. The plan adopted was then to hang sheet-copper corrugations between the joists, and to get water-shed by making the depth of the corrugations 0 at one end, 3½ inches at the other end. It is a difficult construction, and a more expensive one than would have been employed had any latitude whatever been allowed for the work. It gives, however, a very excellent and thorough water-shed covering, and the corrugations furnish a complete protection against straining and tearing of the copper by expansion and contraction of the iron truss due to changes of temperature.

Many serious difficulties were encountered in the prosecution of the work, and these were enhanced by the fact that I could get possession of the bridge only from 11 a. m. till 3 p. m. each day, and fully one-half of this time was consumed in tearing up and

relaying railroad-track to make connections for trains. This part of the work has been completed satisfactorily. I am informed by officers of the railroad company that they are satisfied with the work.

It was also necessary that the machinery for operating the draw be altered and much of it replaced by new and stronger machinery. This work has been begun and pushed as fast as possible, but it is difficult, and requires time and care. It could not be completed before the close of the year, but I believe the agreements made with the railroad company require its completion and authorize the expenditure of the appropriation therefor under section 5, act of Congress approved July 12, 1870. I am therefore going on with the work, and will complete it in time to put in the machinery when the draw is closed for the winter this season. The machinery is being constructed in the arsenal shops.

A serious difficulty has existed at the ends of the draw span and adjacent ends of the other spans. At these ends the whole pressure from car-wheels was on one wooden joist. The load sprung or pressed down this joist generally about 3 inches. The wheel had then to jump a gap of about 3½ inches between the ends of the rails, and of course strike the end of the other rail, which would be about 3½ inches higher than the rail it was leaving. This produced a heavy concussion from every wheel; was injuring the bridge, and a serious accident was apprehended.

I have introduced bolsters and tie-bolts by which two joists and an iron 15-inch beam at each of the four places mentioned are firmly bound together, and their combined strength nearly prevents the bending down under a loaded train. I have also put a lock-bolt under each end of the draw-span, which, when closed, fastens it firmly to the adjacent ends of the other spans, and if the ends of the spans bend downward at all they must bend evenly and simultaneously, and the car-wheels roll smoothly across.

I have never been able to obtain from the Engineer Department complete and satisfactory drawings of the bridge, particularly of the bed of the river (prepared by General Rodman) and of the foundations of the piers. I have prepared a set of drawings which are sufficient for understanding the construction of the bridge, and transmit them herewith.

List of drawings * of the Rock Island bridge:

Drawing S: A general elevation of the whole bridge and plan and elevation of one 217 feet span, (made at Rock Island arsenal from measurement and examination of bridge.)

Drawing T: Side elevation and plans of top chord and bracing, and bottom chord and bracing of draw-span, (copied from drawing obtained from Engineer Department.)

Drawing U: Shows abutments, (copied from drawing obtained from Engineer Department.)

Drawing V: Shows piers, (copied from drawing obtained from Engineer Department.)

Respectfully submitted.

D. W. FLAGLER,
Brt. Lt. Col. U. S. A., Major of Ordnance, Comdg.

E.

Annual report of the principal operations at the Rock Island arsenal, Illinois, for the fiscal year ending June 30, 1876.

SHOP A.

This shop has been completed during the year. The principal work done was as follows: The purchase of the iron for and the manufacture and erection of the iron roof-frame; the manufacture and putting in of the wood-work; the roofing with slate and copper; the putting in of the fire-proof arches; the paving of the basement; the building of stone area walls and steps; the grading and paving around the building and in the court, and putting in water-pipes, sewers, and sewer-pipes in the basement, and painting; the manufacture and erection of the four iron stairways.

The iron roof-frame for this building was manufactured at the arsenal. All of the doors, windows, and other wood-work, and all of the house-hardware for the same were manufactured in the arsenal shops. Nearly all of the last was cast from expanding metal taken from condemned projectiles and scrap obtained from old cartridge-cases.

* These drawings do not accompany this work.

FIRE-PROOF BRICK ARCHES.

The fire-proof brick arches have heretofore been put in by contract, except in Shop D, where the greater portion of the work was done by day-work. But in Shop D such difficulties were encountered that the comparative cost of the two methods of doing the work could not be determined fairly. The law requiring the building to be completed within the fiscal year made it necessary to do the brick-work in one wing of this building (*i. e.*, Shop D) in the fall, as soon as the roof was on. In fact the work could not be so well managed that in some cases the brick-work underneath was not in advance of the slating overhead. Then, the remainder of the roof having been put on in the winter, the rest of the brick-work had to be finished in great haste as soon as the weather would permit in the spring, to get ready for laying the floors, plastering, and painting, all of which had to be completed before June 30.

Storms and intense cold weather set in early in the fall and lasted till late in the spring, so that many serious difficulties were encountered. And in some cases the masonry was frosted before the arches had set, and the mortar dried out, and the arches had to be taken out. Doing one wing at a time made it necessary to rehoist all the arch centers, tracks, hoisting-apparatus, &c., to the top story again, and so change all apparatus from story to story twice. It would be more economical to wait till the whole roof was finished, then do the whole of the top floor first, then the next floor below, and so on. Notwithstanding all this, some saving from the cost of doing the work by contract was made in Shop D last year. This last difficulty was encountered again in Shop A this year, but the work was better managed, and, having good weather both in the spring and fall, it was very economically and well done. I have compared carefully the cost of this work on Shop A with the cost of the same work, when let to the lowest bidder, on Shop C. When the work was done by contract the United States furnished the mortar, delivered where required, furnished all the centers, tracks, and other appliances, did all the hoisting, received, counted, piled, and inspected the brick.

On Shop C the contractor was paid for his part of the work $10,662.61. The cost of the same work done by the United States on Shop A was $7,297.00.

The price of brick was about the same at the two periods of time when the two shops were built. The difference in bricklayers' wages should increase the latter sum only about $360.

The part of the work which had to be done by the United States anyhow could be and was more economically managed when done for ourselves than when done for the contractor.

Moreover, the contractor was paid for his work by measurement. As the United States furnished the mortar, the mortar-joints in the brick-work were more liberal than was desirable. Not only was the work better done when done by ourselves, but certainly a considerable saving of mortar was effected.

The amount of mortar used in Shop C was not determined, therefore I cannot ascertain how much this last saving amounted to.

COPPER-WORK.

I would also ask your attention to a saving effected in the cost of copper-work by doing it in the arsenal shops instead of letting it to a contractor. This refers only to the sheet-copper work—the gutters, valley-peaks, flashings, and down-spoutings. The peak-saddles, down-spouts, dogs, and many other parts have been made and finished in the arsenal shops from the first, and are not considered here. For Shop C the sheet-copper work was let to the lowest bidder, the contractor furnishing his own copper, and cost $12,348.88. For Shop A the United States purchased all the copper and did all the work, and the cost of the sheet-copper work was $7,872.84. Less copper was used, and its market-price was lower for Shop A than for Shop C. The saving from these two causes amounts to $2,232.95, which, being added to the cost for Shop A, and the sum subtracted from the cost of Shop C, leaves a fair saving to the United States from doing its own work of $2,243, or about 20 per cent.

SHOP F.

A rolling-mill and forging-shop for the armory.

The work done on this shop during the year has been the putting up of the walls as far as to include the window-cap course of the whole building; the putting up of the trestle-staging for one-half of the building, and the completion of the walls of one wing. The remainder of the lumber required for the building has been purchased and stacked for seasoning. A portion of the iron for the roof has been purchased, (not yet paid for,) and a considerable portion of the stone still required to complete the walls.

Referring to my report upon the foundations of this shop in my annual report of last year, I have to say that it cannot be determined by observation that there has been

any unequal settling of the walls, and I have filled up one of the gaps left at the juncture of the clay and rock foundation.

As this is a one-story building only, the frieze windows, which have been put in the other shops for lighting the third story, were not required. To obtain sufficient height for the frieze windows, the frieze (in the other shops) has been much higher than the proportions required in architecture will allow. This has been injurious to or lessened the effect of the entablature by separating too widely the architrave and cornice, and the wide separation is made more apparent because the frieze is left undressed. Its height would make dressing the stone expensive. In Shop F the frieze has been reduced to 24 inches and dressed, (bush-hammered.) The effect is better, and the cost less.

FURNISHING POWER TO SHOPS ALREADY BUILT.

The work under this head during the year has been the construction of penstocks, water-wheels, mill-machinery, and a wire-rope transmission, for transmitting 300 horse-power from the water-power dam to Shops E and C, now in use, in accordance with plans submitted to the Chief of Ordnance, April 8th, 1874, and approved.

The act of Congress, approved July 12th, 1870, requiring unexpended balances of appropriations to be covered into the Treasury at the close of the fiscal year, made it necessary to complete the work, if completed at all, before the close of the fiscal year, June 30th, 1876.

The time allowed, under the law, for the construction and erection of such machinery was short, still the work could have been completed within the year had it been possible to put in the machinery. But this was impossible, if any proper regard was paid to economy. To put in the water-wheels, penstocks, and some other parts of the machinery, it was necessary to build coffer-dams in the river, around the site of the work, and pump out the water. Coffer-dams, of sufficient height for low water, were put in the year before, and left in readiness for this work, when the water should be low enough to admit of pumping out.

The machinery could not be completed before winter, so that, if it were put into position at all during the fiscal year, the work had to be done in the spring, near the close of the year; that is, in May or June. During these two months the high stage of water in the river occurs, the water being ordinarily about 13 feet above low water. To do the work at this time, then, would have required the construction of new coffer-dams of great strength, about 22 feet high, and the pumping out of the deep water. The expense of this work would have consumed all of the appropriation that was left for putting in the machinery, and the work itself would have been exceedingly difficult. It was totally unnecessary, except for a compliance with the law requiring the work to be completed within the fiscal year, because the desired low stage of water begins in August, and after that the work could be done easily and without expense.

I therefore wrote to you on May 4th, 1876, stating these facts, and asked, if possible, that something might be done by act of Congress, or otherwise, to procure an extension of the time in which the work could be done. I have not yet received information as to whether this extension of time asked for has been granted.

The work of constructing the machinery was carried forward till the close of the year, nearly completed, and left in condition to be completed and put in position this fall, if it is permitted. Enough of the appropriation ($3,625) is left for completing the work.

It was designed to put in at present only four water-wheels, with the necessary machinery, and transmission-machinery. All of this machinery, the iron penstocks and fixtures, have been constructed in accordance with plans submitted to you April 8, 1874. The work has all been done in the arsenal shops.

THE WATER-WHEELS.

In my report giving plans referred to above, it was stated that turbine wheels would be used, but that the particular pattern of wheel had not been decided upon.

There is now manufactured in the country an almost endless variety of these wheels, and among the numerous very excellent wheels there is no such marked superiority of any particular one over the others as to make a choice a very easy matter, except that the peculiarities of some adapt them specially to special localities. The strong partisanship among the manufacturers complicated the difficulty of determining the best wheel for this place.

If it had been possible it would have been very desirable to put in a testing-flume at this place, and to have allowed manufacturers to bring their wheels here for a competitive test, but the difficulties attending this were so great as to make it certainly impracticable and almost impossible. One or two years would have been required for making the tests, and under the laws governing appropriations it would have been impracticable to get money for making the tests properly. It would have required a special construction of the dam for the testing-flume, and the varying stage of water in

the river would have made the construction of a *good* testing-flume nearly impossible. Moreover, my experience has shown that the results of tests are subject to so much criticism that although they might have been of use to the Government they would not have satisfied competitors.

I have, therefore, confined my investigation of this subject to visiting the establishments of wheel-manufacturers, inspecting the wheels and their manufacture, witnessing tests of wheels when I could, inspecting wheels in use at various places, consulting the users of wheels, and studying the record of official tests of wheels whenever I could get them, and in this way have given much attention to the subject throughout a period of three years.

The wheel selected is the Houston wheel, (sometimes called the Beloit wheel,) manufactured by Merrill & Houston, at Beloit, Wis. I believe the percentage of power obtained by this wheel is as good, or nearly as good, as any; it is an economical wheel, simple and very strong, and the nearness of the manufacturers to the arsenal was a matter of some importance. The strength and simplicity of a wheel is of the utmost importance at this place, where drift-wood has to be contended with. It is possible that the Swain wheel (Lowell, Mass.) may give a little better percentage of power than the Houston wheel, and I am satisfied that it does when used as a *part gate*, but the great number of wheels to be used here makes their *part-gate* use of little importance.

The Swain wheel is expensive and delicate, suited only to well-strained water like that at Lowell, and the distance of the manufacturers would make the supplying and care and preservation of the wheels at this place troublesome.

I have taken so much pains to give the reasons having weight in the selection of a wheel, because the placing of wheels at this place was valuable to manufacturers as an advertisement, and this has created competition, and no matter what wheel was selected, I knew it would produce much feeling.

The 65-inch diameter wheel has been employed, and this I estimate will give, with 7 feet of head, 62½ horse-power per wheel. (The manufacturers rate the wheel with 7 feet of head at 67½ horse-power.)

The manufacturers' price for this wheel is $1,300; but in consideration of the number of wheels (40) to be used, they made a verbal offer to supply them at their works for $1,125. The freight and handling would have made the cost $1,150.

In consequence of the excellent foundery and machine-shop facilities at this arsenal, I thought it would be more advantageous to make the wheels here, and finally made an arrangement with the owners of the wheel to pay them 2½ cents per pound for the use of their patent, patterns, drawings, and templets; they binding themselves to furnish the same at the same or a less price hereafter, if more wheels should be required. The weight of the wheel completed is 11,265 pounds.

The amount paid to the owners is $281.62 per wheel. This, added to the cost of manufacture here, has made the total cost of the wheels $779.58 each.

I earnestly wish that, if practicable, some arrangement could be made by which this work could be completed and the power put in use.

CARE AND PRESERVATION OF BUILDINGS AND IMPROVEMENT OF GROUNDS, ROADS, ETC

The work which has been done under this head during the year is principally the following:

Repairs of permanent buildings and necessary painting, and repairs of roads.

Repairs of water-power gates and other repairs of water-power.

Prosecution of work on West avenue, between Main avenue and the south shore of the island.

A considerable part of South avenue and the ground between South avenue and Shops C and A has been graded and macadamized.

Stone walks have been laid along First and Second streets, and curbing and gutters put in.

The ground in front of Shop D has been graded. Main avenue, from First to Second street, has been completed, curbing and gutters put in, and walks laid along each side of it.

Nine hundred linear feet of stone walk have been laid along Main avenue, from West avenue westward toward the arsenal entrance, and gravel put on this part of the avenue.

The 8-inch water-pipe main has been put in along West avenue, from South to North avenue, and also from the intersection of Fourth street and South avenue, along South avenue to East avenue, and from that point to the river, at the point near the water-power dam selected for the location of the large pump to be driven by the water-power. The pipe for this work was manufactured in the arsenal foundery.

The removal of the rock ledge and the grading of the grounds between the officers row of quarters and the main river has been completed from West avenue east to include the ground in front of the most eastern set of quarters that is built. The road,

marked "X Y," has been built, a hedge has been planted and a fence built to protect the same while it is growing, and some other fences have been built around the officers' quarters.

A cast-iron fence, made at the arsenal, has been put up in front of the officers' quarters.

This is a handsome and durable fence, and, as I believe, its cost is much below the ordinary cost of such fences. I think it possible that, in some cases, such a fence could be manufactured and transported to other arsenals cheaper than it could be purchased. The greatest saving in cost was effected by making the castings with such nicety as to avoid the cost of fitting.

This is shown in the details of cost. Usually such fences are set on a cut-stone or brick base. This base was not used because, in this climate, a foundation-wall three or more feet deep would have been required to secure the base from the action of frost, and this, I estimated, would cost more than the rest of the fence. Since the fence has been completed, I think the placing of the bottom rail 5 inches above the well-graded and well-kept greensward is quite as sightly as a stone base would be.

The 1 or 1½ feet of broken rock is placed under the post to protect it from the action of frost, and then the post-hole is filled with broken rock to the surface of the ground. This makes the post and fence firm, and I do not think it will ever become loose or get out of line, for the tendency of the broken rock is always to settle or rattle downward when the fence is shaken, and to wedge the post more firmly.

The cost of the bottom piece of the iron post was inconsiderable, because it was cast from the last run of metal from the furnace. This metal would otherwise have been run into bars for smelting.

I find this plan for making and setting fence-posts will be better and cheaper for wooden fences than the plan which was sent from the armory, and which has hertofore been used at this arsenal. This plan was to plant a heavy stone, and drill and plant in it a bar of 1¼-inch iron. The iron base (with the bar in it) can be more readily removed, and replanted when a fence is removed.

Besides the foregoing, much work has been done in the grading and improvement of grounds, and 328 shade-trees and 1,800 feet of hedge have been planted.

A large expense has always to be incurred at this arsenal in the removal of dead trees and wood from the forest part of the island, in cutting and removing weeds and underbrush, and in taking care of so much ground and grass. It would be impossible, without a large annual expenditure, to keep the whole island in anything approaching the neatness desirable for an arsenal.

ROCK ISLAND BRIDGE.

Beside the ordinary work of care and preservation, maintaining of guards, and operating the draw, the work under this head during the year has been as follows:

The whole of the wagon-bridge between the island and city of Rock Island has had a new 3 inch oak floor laid on it, and about one-half of the bridge to Davenport has been relloored. (The extensive use of the bridge by the public will generally require a renewal of these floors once in three years.)

All of the iron-work of the bridge from the island to Davenport has been painted two coats. This was an important work, and its total cost was $6,465.15. The work has been thoroughly done, and the painting should last from eight to ten years.

When the bridge was completed, the paint put on by the contractors was not of good quality and the work was badly done, or it would not have required renewal so soon.

Considerable repairs of the street connecting the ends of the bridges have been made, the causeway from the island shore to the Rock Island wagon-bridge has been covered with macadam, and a substantial oak-timber fence has been built along both sides of the causeway, and along the island shore between the bridges. Also, a foot-walk has been built across the island between the bridges.

The new machinery for the draw referred to in my last annual report has been completed and was put in position after the close of navigation last winter. Quite a serious accident happened to the draw on June 6, 1876, a report of which was sent to you in my letter dated June 7, 1876, as follows:

"ROCK ISLAND ARSENAL, ILLS.,
"*June* 7, 1876.

"TO THE CHIEF OF ORDNANCE,
"*U. S. Army, Washington, D. C.:*

"SIR: I have the honor to report that yesterday, at 1:30 p. m., while the draw of the Rock Island bridge was being swung, and before it could be latched, it was caught by a violent and sudden squall of wind; the engineer could not control it: it was driven past the *rests* and the bottom sheaves brought against the anchors for the wire-cables on the draw pier. Both bottom sheaves, both side brackets, and both cables were broken. The total cost for repairing will be about $310, and will require three weeks.

In the mean time the draw is operated by the portable engine on the upper-draw rest. I cannot find that there was any neglect or fault on the part of the employés at the bridge, except that the engineer should have refused to open the draw, because the approach of the storm was apparent. The engineer states that he saw the storm approaching, but that when he opened the draw there was no wind at all, and he thought he could get the draw latched again before the squall arrived. The wind was almost a hurricane for a few minutes, and of such force as to tear down trees and buildings. It would be impossible with proper machinery to control the draw if opened and swinging in such a wind.

"Very respectfully, your obedient servant,

"D. W. FLAGLER,
"*Major of Ordnance.*"

The damage done has been fully repaired, except that only one of the heavy iron brackets that carry the bottom iron-rope sheaves has been replaced. The other was only cracked, and has been sufficiently strengthened to admit of its use until the close of navigation. A new one has been made for the place and will be put in as soon as navigation closes.

Considerable difficulty has been met during the year in maintaining proper order on the bridges. I cannot see, however, any means of avoiding these difficulties. They seem to be inseparable from the use of the bridges by the public, in connection with the absence of any law or other means for the punishment of offenders. Arrests of disorderly persons have sometimes been imperative, and I have felt much apprehension of trouble in making such arrests without proper protection of law.

Mr. A. F. Fleming, formerly master-armorer at the arsenal and at the Watertown arsenal, has been in charge of the bridge and bridge-guards during the year, and I feel that much is due to him for his careful attention and good sense and judgment in dealing with offending parties. Following is an abstract of the number of vehicles, foot-passengers, trains, cars, and engines that have passed over the bridge during the year. The rule adopted in making arrests is that when parties assault the guards and cannot be controlled, or commit acts that the guards deem crimes against the laws of the United States, they may be arrested and confined until examined by an officer to ascertain whether a warrant for their arrest should be obtained, and they turned over to a United States marshal.

Abstract of record of the Rock Island bridge for fiscal year ending June 30, 1876.

PASSING NORTH.

Engines with trains	3,445	
Engines without trains	121	
Total engines		3,566
Passenger-cars		4,748
Freight-cars		62,603
Foot-passengers		201,184
Teams		118,858
Steamboats		999
Barges		444

PASSING SOUTH.

Engines with trains	3,466	
Engines without trains	119	
		3,585
Passenger-cars		4,711
Freight-cars		63,352
Foot-passengers		207,301
Teams		118,109
Steamboats		1,015
Barges		428
Rafts		643

In obedience to instructions contained in the letter of Chief of Ordnance, dated June 18, 1875, the manufacture of infantry and cavalry equipments was commenced at this arsenal during the year.

New machinery and the expense of fitting up a shop was paid for principally out of an appropriation for machinery and shop-fixtures for the arsenal. But, as this appropriation was exhausted before the close of the year, some of the machines, especially sewing-machines, and many tools and appliances had to be purchased out of funds

appropriated for the work. This and some other difficulties peculiar to a commencement of new work made the cost of the equipments greater than they should be in subsequent years. New workmen had to be employed and taught their work. Delays occurred in procuring materials of proper quality, so that nearly all the work was crowded into the last six months of the year, and in several ways prevented an economical management of the work. These delays affected the manufacture of infantry-equipments particularly. All of the orders for manufacture were completed, except a portion (1,160 sets) of the infantry-equipments.

CLEANING AND REPAIRING BREECH-LOADING RIFLES, MODELS OF 1868 AND 1870.

In obedience to instructions contained in the letter of the Chief of Ordnance, dated February 22, 1876, this work was commenced March 1, 1876.

Up to the close of the year, June 30, 1876, 3,700 rifles had been cleaned, repaired, and packed, at a cost of $4,140.16. Of this, $427.32 was for tools and fixtures. This makes the cost per arm $1.12. The expense for work-benches, shafting, and shop-fixtures was paid for out of the appropriation to the arsenal for machinery and shop-fixtures.

In consequence of receiving orders for supplies for the cleaned and repaired arms to governors of States, the work was commenced and hastened before polishing-wheels and some other conveniences for doing the work economically could be provided, and, also, at the beginning many of the workmen had to be taught.

The necessary appliances for doing the work economically are now provided, and I estimate that the arms can be cleaned and repaired hereafter at a cost of not more than $1 each.

Most of the arm-chests in which the arms were received were in very bad order, and many of them were made for arms of other patterns, and had to be altered. Many of the chests were irreparable, and were replaced by new ones.

The cost of this work was as follows:

71 new chests manufactured, at $3.51¼ each	$249 68
103 old chests repaired	127 72

This is included in the cost of cleaning and repairing arms.

The arm-chests were made of clear lumber in small lots, as required, and sometimes workmen more expensive than necessary were employed on them. They can be made of clear lumber, in lots of 100, for $3.25. This estimate of cost is made with care, because I notice on price-lists of stores that arm-chests are put down at $3.50. They ought to be made as cheaply here as anywhere, and with eight hours for a day's labor they will cost the price given, $3.25.

ARTILLERY AND SMALL-ARMS AMMUNITION BROKEN UP.

A report of unserviceable and [illegible] ammunition turned in from the Army and broken up during the year is appended hereto. I respectfully ask attention to the report of Lieut. J. C. Ayres of the methods employed in breaking up the metallic center-primed cartridges.

Supposing that caked powder in the cases might be affected by the fulminate in the cartridges, and thus rendered somewhat unsafe for storage purposes, and the cost and danger of removing it being considered, the attempt was made to save not only the lead, but the powder was extracted from the cases and saved for such cartridges as they and for [illegible] purposes at the post.

The method employed for burning out the caked powder [illegible] and of saving the copper is very safe and [illegible] and [illegible] of the preservation of the cases for future use [illegible] The invention [illegible] the use of the iron cage described [illegible] that [illegible] the cases in such a way that [illegible] the bottom of the cases [illegible] strengthened by [illegible] [illegible]

About [illegible] cases [illegible] The [illegible] cases [illegible] and [illegible] the whole [illegible] per [illegible]

[illegible]

The [illegible] heavy [illegible]

shop. The sides were made of boiler-iron, perforated with small holes to allow an easy escape for the gas; and to further secure this object, as well as to allow free entrance to the flame of the fire, the top and bottom were made of crossed iron bars. The cover was fastened to the box by four strong hoops and staples. The handle was fastened at the middle of two opposite sides of the box, and so arranged that the entire box would readily turn over in the handle. A beam 22 feet long, turning on a pivot 6 feet from the end to which the box was attached by chains, was used to carry the box over the fire. The weight of the box was balanced by a counterpoise, and the men were protected by an embankment of earth and a wooden barricade. On one side of the apparatus was placed a water-tank for cooling the box, and on the other a bin for the exploded shells.

"The mode of working was as follows: The box was charged with from 1,000 to 1,500 shells, firmly closed, and swung over the fire by one man working at the longer end of the lever. It was kept there until all the shells were exploded, and then swung round, dipped in the tank, and finally the shells were dropped into the bin. The whole operation ordinarily occupied about six minutes.

"At first I had the shells put into water and the powder scraped out, so far as possible, before they were exploded; but I soon found that this was useless trouble, as it was perfectly safe to explode them with the caked powder remaining in them, and much more expeditious. The carbine-cartridges, caliber .45, required a longer time than the others, as they had wads in them, and did not explode till the copper was heated to the temperature necessary to discharge powder. The report was also much louder and the recoil of the shells more violent, so that the charge had to be decreased. Considerable time was expended in experiments, and wasted, owing to the box not being strong enough when first made, so that the average cost of exploding this lot of shells was from 15 to 20 cents per thousand; but I am convinced that two men can explode 60,000 shells in a day, of all kinds, except those containing wads, and 30,000 of the latter. This would be at the rate of 5 and 10 cents per thousand.

Respectfully submitted.

D. W. FLAGLER,
Brt. Lt. Col. U. S. A., Major of Ordnance, Comdg.

F.

[GENERAL NATURE—No. 46.]

AN ACT making appropriations for sundry civil expenses of the Government for the fiscal year ending June thirty, eighteen hundred and seventy-two, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, for the objects hereinafter expressed, for the fiscal year ending the thirtieth of June, eighteen hundred and seventy-two, viz:

* * * * * * *

ARMORIES AND ARSENALS.

For completing the bridge at Rock Island, being an unexpended balance covered into the Treasury under the act of July twelve, eighteen hundred and seventy, five hundred thousand dollars.

For Rock Island armory and arsenal, Rock Island, Illinois: Continuing the development of water-power, two hundred thousand dollars; permanent forging-shop, two hundred thousand dollars; constructing permanent workshop, two hundred thousand dollars; purchasing and laying pipe, eight thousand dollars; two blocks of subaltern officers' quarters, fifty-five thousand dollars; macadamizing main avenues and streets, five thousand dollars; tools and machinery required for new shops nearly completed, twenty thousand dollars.

Approved March 3, 1871.

AN ACT making appropriations for sundry civil expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and seventy-three, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, for the objects hereinafter expressed, for the fiscal year ending June thirtieth, eighteen hundred and seventy-three, viz:

ARMORIES AND ARSENALS.

Rock Island armory and arsenal, Rock Island, Illinois: For new forging-shop of same dimensions and architecture as shops already built, except that it will be only one story

high, one hundred and fifty-five thousand dollars; for new finishing-shop for armory, two hundred thousand dollars; for new fire-proof barracks for enlisted men, including mess-building, bakery, and laundry-building, ninety-five thousand dollars; for new powder-magazine, fifteen thousand dollars; for completing development of the water-power, one hundred and ten thousand dollars; for the construction of avenues and roads to the Rock Island wagon-bridge and to the new bridge across the Mississippi River to the city of Davenport, and for building a railroad to connect the present arsenal railroad with the Chicago and Rock Island Railroad when changed to its new location at the lower end of the island, and for building two entrances to the island from the two bridges, and an iron fence connecting the two entrances, and between the railroad and the public wagon-road on one side and the arsenal on the other side, twenty-eight thousand dollars; for new machinery for the new shops already completed, twenty thousand dollars; for laying water-pipe, three thousand dollars; for putting six water-wheels (sixty-five horse-power each) in the new dam, with shafting and machinery for transmission of power to the shops already in use, twenty-six thousand dollars; in all, six hundred and fifty-two thousand dollars.

For completion of the wagon-road bridge connecting Moline with Rock Island, one hundred thousand dollars.

For the construction of the Rock Island bridge, the balance of the appropriation, continued by the act of March third, eighteen hundred and seventy-one, which may be unexpended at the close of the present fiscal year, is hereby re-appropriated.

Approved June 10, 1872.

AN ACT making appropriations for sundry civil expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and seventy-four, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, for the objects hereinafter expressed, for the fiscal year ending June thirtieth, eighteen hundred and seventy-four, namely:

* * * * * * *

ARMORIES AND ARSENALS.

Rock Island arsenal, Rock Island, Illinois:

For a new wood-working and gun-carriage shop, two hundred and thirty thousand dollars.

For the completion of new finishing-shop for armory, one hundred and fifty thousand dollars; and for one set of subaltern officers' quarters, twenty-three thousand seven hundred and fifty dollars; in all, one hundred and seventy-three thousand seven hundred and fifty dollars.

For forges, foundery, chimneys, machinery, and shop-fixtures for forge-shop, fifty thousand dollars.

For machinery and shop-fixtures for Shop C, as laid down on the plan adopted by the War Department, fifteen thousand dollars.

For improvement of grounds, building of new roads, and care and preservation of the same, eight thousand dollars.

For paving the basements of Shops B and C, as laid down in plan adopted by the War Department, twenty-one thousand eight hundred and fifty dollars.

For a new guard-house, fire-engine house, and quartermaster's and commissary storehouse, twenty-seven thousand five hundred dollars.

For machinery for transmitting power from the water-power to shops, eighteen thousand dollars.

For painting of buildings and fences, and for care and preservation of water-power and public buildings, ten thousand dollars.

Approved March 3, 1873.

AN ACT making appropriations for sundry civil expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and seventy-five, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, for the objects hereinafter expressed, for the fiscal year ending June thirtieth, eighteen hundred and seventy-five, namely:

* * * * * * *

ARMORIES AND ARSENALS.

For Rock Island arsenal, Rock Island, Illinois:

To continue work on the wood-working and gun-carriage shop for the arsenal, one hundred and fifty thousand dollars.

For a new rolling-mill and forging-shop for the armory, ninety-five thousand dollars.

For roofs, floors, doors, windows, and other work for completing the finishing-shop, eighty thousand and five hundred dollars.

For repairs and completion of a stone reservoir, as follows: For a water-tight interior wall, floor, and roof, five thousand and one hundred dollars; for water-pipe and laying the same, five thousand seven hundred and fifty dollars; for Rock Island water-power, five thousand and four hundred dollars.

For Rock Island bridge:

For alterations and repairs and additional machinery, (for draw of the bridge,) and for care and preservation, twenty-three thousand and four hundred dollars; one-half of which sum shall be re-imbursed to the Government by the Chicago, Rock Island and Pacific Railroad Company.

For sewers, building new roads, care and preservation of water-power, painting and care and preservation of permanent buildings and bridges, building fences, and grading grounds, and repairs and extension of the railroad, twenty thousand dollars.

For new machinery and shop-fixtures for shops, fifteen thousand dollars.

Approved June 23d, 1874.

AN ACT making appropriations for sundry civil expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and seventy-six, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, for the objects hereinafter expressed, for the fiscal year ending June thirtieth, eighteen hundred and seventy-six, namely:

* * * * * * *

ARMORIES AND ARSENALS.

For Rock Island arsenal, Rock Island, Illinois:

For Shop A: For a wood-working and gun-carriage shop for arsenal, one hundred and seventy-eight thousand dollars.

For Shop F: For a rolling-mill and for forging-shop for the armory, seventy-five thousand dollars; and one hundred thousand dollars of said appropriation for Shops A and F shall be available immediately.

For furnishing power to the shops already built, eighteen thousand five hundred dollars.

For Rock Island bridge:

For care and preservation of the bridge, thirteen thousand dollars; and this sum and the appropriation for said bridge for the fiscal year ending June thirtieth, eighteen hundred and seventy-five, shall be expended in accordance with the joint resolution in relation to the Rock Island bridge, approved July twentieth, eighteen hundred and sixty-eight, and the contract between the United States and the Chicago, Rock Island and Pacific Railroad Company; and the Secretary of War shall, within six months from the passage of this act, notify said railroad company to remove from said island and from the Mississippi River all piers, abutments, embankments, erections, structures, or tracts connected in any way with the old bridge or tracks of said railroad company over or across said island or either branch of said river; and in case of refusal of said railroad company to comply with such notice for the period of six months, then it shall be the duty of the Attorney-General of the United States to commence, or cause to be commenced, such legal proceedings against said railroad company as may be necessary to protect and enforce the rights of the United States in that behalf: *Provided, however*, The Secretary of War may permit the north pier of the old bridge to remain, in accordance with the joint resolution of Congress approved March third, eighteen hundred and seventy-three.

For sewers, building new roads, care and preservation of water-power, painting and care and preservation of permanent buildings and bridges, building fences and grading grounds, and repairs and extension of the railroad, fifteen thousand dollars.

For new machinery and shop-fixtures for shops, ten thousand dollars.

Approved March 3d, 1875.

AN ACT making appropriations for sundry civil expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and seventy-seven, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated for the objects hereinafter expressed, for the fiscal year ending June thirtieth, eighteen hundred and seventy-seven, namely:

* * * * * * *

ARMORIES AND ARSENALS.

Rock Island arsenal:

For a rolling-mill and forging-shop (Shop F) for the armory at Rock Island arsenal, Rock Island, Illinois, seventy-five thousand dollars, in addition to the unexpended balances of appropriations for the year ending June thirtieth, eighteen hundred and seventy-four, which are hereby made available for the service of the fiscal year ending June thirtieth, eighteen hundred and seventy-seven.

For an iron-working and finishing shop (Shop G) for the arsenal, thirty thousand dollars.

For sewers, new roads, care and preservation of water-power, of permanent buildings and bridges, including painting, building fences, and grading grounds, and repairs, and extension of railroads, twenty-two thousand dollars.

For care and preservation of the Rock Island bridge, nine thousand dollars.

Approved July 31, 1876.

G.

MILITARY PRISON.

On the 9th of May, 1872, House of Representatives bill No. 2692 was read twice in the Senate and referred to the Committee on Military Affairs.

This bill provided for the establishment of a military prison at Rock Island, and for its government, and had passed the House of Representatives on the 7th of May, 1872.

The following act of Congress was approved March 3, 1873:

"AN ACT to provide for the establishment of a military prison, and for its government.

"*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That there shall be established at Rock Island, in the State of Illinois, a prison for the confinement and reformation of offenders against the rules, regulations, and laws for the government of the Army of the United States, in which shall be securely confined and employed at labor, and governed in the manner hereinafter directed, all offenders convicted before any court-martial or military commission in the United States, and sentenced according to law to imprisonment therein.

"SEC. 2. That the Secretary of War shall organize a board of five members, to consist of three officers of the Army and two persons from civil life, who shall adopt a plan for the building of such prison, and who shall frame regulations for the government of the prisoners, in accordance with the provisions of this act. The said commissioners from civil life shall hold their offices for the term of three years, and shall be paid five dollars a day while on duty, and necessary traveling-expenses; and the said officers of the Army shall, at all times, be subject to removal by the Secretary of War.

"SEC. 3. That the Secretary of War shall, with said commissioners, semi-annually, and as much oftener as may be deemed expedient, visit said prison for the purposes of examination, inspection, and correction; and they shall inquire into all abuses or neglects of duty on the part of the officers or other persons in charge of the same, and make such changes in the general discipline of the prison as they may hold to be essential.

"SEC. 4. That the officers of the prison shall consist of a commandant and such subordinate officers as may be necessary, a chaplain, a surgeon, and a clerk, who shall be detailed by the Secretary of War from the commissioned officers of the Army; and a sufficient number of enlisted men shall be detailed by the Secretary of War to act as turnkeys, guards, and assistants in the prison.

"SEC. 5. That one of the inspectors of the Army shall, at least once in three months, visit the prison for the purpose of examining into the books and all the affairs thereof, and ascertaining whether the laws, rules, and regulations relating thereto are complied with, the officers are competent and faithful, and the convicts properly governed and employed, and at the same time treated with humanity and kindness. And it shall be the duty of the inspector, at once, to make full report thereof to the Secretary of War.

"SEC. 6. That before the commandant enters upon the duties of his office, he shall

give bond, with sufficient sureties, in a sum to be fixed by the Secretary of War, to be approved by him, conditioned that he shall faithfully account for all moneys placed in his hands for the use of the prison, and for the faithful discharge of all his duties as commandant. He shall have command of the prison; shall have the charge and employment of the prisoners, and the custody of all the property of the Government connected with the prison. He shall receive and pay out all money used for the prison, and shall cause to be kept, in suitable books, complete accounts of all the property, expenses, income, business, and concerns of the prison; and shall make full and regular reports thereof to the Secretary of War; and shall, under the direction and with the approval of the Secretary of War, employ, for the benefit of the United States, the convicts at such labor and in such trades as may be deemed best for their health and reformation. He shall have power to sell and dispose of any articles manufactured by the convicts, and shall regularly account for the proceeds thereof, and shall give bond and security for the faithful keeping and accounting of all moneys and property coming to his hands as such commandant. He shall take note and make record of the good conduct of the convicts, and shall shorten the daily time of hard labor for those who, by their obedience, honesty, industry, or general good conduct, earn such favors; and the Secretary of War is authorized and directed to remit, in part, the sentences of such convicts, and to give them an honorable restoration to duty in case the same is merited; and in case any convict shall disobey the lawful orders of the officers of the prison, or refuse to comply with the rules and regulations thereof, he may be placed in solitary confinement, and the commandant shall at once report the case to the Secretary of War, who shall direct the inspector to make full examination and report of the matter at the next inspection; but in no case shall any prisoner be subjected to whipping, branding, or the carrying of weights for the purpose of discipline, or for producing penitence; and every prisoner, upon being discharged from prison, shall be furnished with decent clothing.

"SEC. 7. That the use of newspapers and books shall not be denied the convicts at times when not employed; and that unofficial visitors shall be admitted to the prison under such restrictions as the board of commissioners may impose. The prisoners shall not be denied the privilege of communicating with their friends by letter, and from receiving like communications from them, all of which shall be subject to the inspection of the commandant, or such officer as he may assign to that duty.

"SEC. 8. That the prisoners shall be supplied with ample and clean bedding, and with wholesome and sufficient food; but when in hospital, or under discipline, their diet shall be prescribed by the proper authority. The prison shall be suitably ventilated, and each prisoner shall have a weekly bath of cold or tepid water, which shall be applied to the whole surface of the body, unless the surgeon shall direct otherwise for the health of the prisoner.

"SEC. 9. That no officer of the prison, or other person connected therewith, shall be concerned or interested, directly or indirectly, in any contract, purchase, or sale made on account of the prison.

"SEC. 10. That any officer who shall suffer a convict to escape, or shall in any way consent to his escape, or shall aid him to escape, or in an attempt to escape, shall, upon conviction, be dismissed from the service, and suffer such other punishment as a court-martial may inflict.

"SEC. 11. That any soldier or other person employed in the prison who shall suffer a convict to escape, or shall in any way consent to his escape, or shall aid him to escape, or in an attempt to escape, shall, upon conviction by court-martial, be confined therein not less than one year.

"SEC. 12. That all prisoners under confinement in said military prisons, undergoing sentence of courts-martial, shall be liable to trial and punishment by courts-martial, under the Rules and Articles of War, for offenses committed during the said confinement."

Approved March 3, 1873.

On February 13, 1873, I addressed the following letter to the Chief of Ordnance:

"BOARD ON HEAVY-GUN CARRIAGES,
"*Army Building, New York City, February 13th*, 1873.

"The CHIEF OF ORDNANCE,
"*Washington, D. C.:*

"SIR: I have the honor to submit for your consideration the following remarks relative to the establishment of a military prison at the Rock Island arsenal.

"It is to be presumed that the reasons to be advanced for the establishment of a prison at so unusual a place as an arsenal would be—

"First. That the labor of the prisoners might be applied to the work carried on at the arsenal.

"Second. That, the arsenal being situated on an island, the location might furnish safety from escape of prisoners.

"Both of these reasons are fallacious, because—

"1st. The prisoners could not be employed on arsenal-work.

"(*a*) Arsenal-work is of such a character that it would be unsafe to intrust it to prisoners, or to any disaffected person. The experience of our last war has shown the danger of intrusting the production of material of war to any but thoroughly loyal and competent persons, devoted to the interests of the United States. It is extremely easy for an employé inclined to do so to introduce imperfections into such material, and also at times to render such material, particularly ammunition, highly dangerous.

"(*b*) Even if it was safe to intrust the work to prisoners, they are incompetent. Arsenal-work requires skilled workmen. Military prisoners would come to the work without skill; and the ordinary time of their incarceration would be insufficient for the acquirement of the necessary skill and experience or for officers to ascertain whether they could be intrusted with work.

"2d. The island does not offer the supposed safety from escape. During the summer the shallow water along the Illinois shore offers little or no obstruction to the escape of a prisoner. During the remainder of the year there is a perfect bridge of ice around the whole island, and no obstruction to escape. A wall around the prison would be required, as in other localities. Moreover, the arsenal would offer unusual and very great facilities for the escape of prisoners. When in active operation, several thousand workmen will be employed in the arsenal. Unless a surveillance so strict as to interfere materially with the operations of the arsenal were employed, these workmen could connive easily and successfully at the escape of prisoners, especially if the prisoners were employed at work with the other employés.

"The foregoing is only intended to show the fallacy of any known reasons for introducing a prison into an arsenal. But it is believed that the serious injury which such a course would inflict upon the arsenal would render insignificant in comparison any benefit that could accrue to the prison.

"It is well known that Congress is building at Rock Island probably the greatest and finest arsenal in the world. It is a great national institution, upon which the whole country should look with pride. But it is built entirely for use, and is a main feature in our military system of defense, and we cannot consistently do anything that will diminish its safety and capacity for work, or its completeness and perfection.

"It was with a full understanding of the plans for the arsenal that Congress expended so much legislation and money to exclude every claimant from a foothold on the island, and set it aside exclusively for the great establishment that is now being built.

"The introduction of a prison into the arsenal is completely antagonistic to the plans of the Government for the place.

"1st. All the great bridges, avenues, and railroads built to the arsenal are no more than sufficient to transact the business of the arsenal when in full operation, even when used to their best advantage. If these bridges and roads become avenues to a prison, they would be obstructed to the full extent required for safety, and could not then transact the business of the arsenal; that is, for arsenal purposes we want them open to their full capacity for work, and for the admission of people on business, and workmen; for prison purposes we want them gated and guarded.

"2d. The most important element in an arsenal is safety. Nothing should be left undone which can add to its safety from accident, explosion, fire, or any other injury.

"The introduction of a prison is deliberately introducing an element of danger. The prisoners must be looked upon as disaffected persons, probably enemies, and some of them, as shown by experience, are insane in their enmity, and the most dangerous of incendiaries.

"3d. Rock Island arsenal is to be a great national establishment, perfect in every respect. By introducing an antagonistic establishment the arsenal becomes crippled and imperfect, and the plans of Congress are defeated.

"I will cite, in conclusion the history of the Washington arsenal. A penitentiary was located near it, but entirely outside the arsenal, and separated from it by a high wall. Even its proximity was deemed so dangerous that during the war the prisoners were removed and the prison was torn down and taken away. The objections to a prison, even in the vicinity of Rock Island arsenal are much greater, because of the character of the establishment.

"If the matter were fully understood, it does not seem possible that Congress would appropriate money to build a prison *within* the arsenal.

"Very respectfully, your obedient servant,

(Sigd.) "D. W. FLAGLER,

"*Captain of Ordnance, Brevet Lieut. Col., U. S. A.*"

The above letter was submitted to the Secretary of War by the Chief of Ordnance, with the following indorsement:

"ORDNANCE OFFICE, *February 14th*, 1873.

"Respectfully submitted to the Secretary of War.

"The Rock Island arsenal is intended to be a grand manufacturing establishment;

when in operation a portion of its manufactures will consist of dangerous explosives, requiring the utmost care in their manipulations. Magazines stored with gunpowder and other explosives must necessarily constitute part of the arsenal, and it is submitted that none but reliable persons should be employed upon the island.

"It is not believed that the prisoners could be made use of to advantage, except as laborers on the roads and grounds, and scattered, as they would necessarily be, over an island of 1,000 acres, the guards for their supervision and care would have to be much larger than in an ordinary prison where they are confined within high walls.

"The competition between convict and ordinary labor, when brought in contact, always leads to ill-feeling and irritation.

"It is the opinion of this bureau that the interests of the public service will be best subserved by having the prison establishment elsewhere than at the Rock Island arsenal.

"By order of the Chief of Ordnance:

(Sigd.) "S. V. BENÉT,
"*Major of Ordnance.*"

Letter of Adjutant-General of the Army, dated May 31st, 1873.

Appoints certain officers members of board on military prison.

"WAR DEPARTMENT, ADJUTANT-GENERAL'S OFFICE,
"*Washington, May 31st,* 1873.

"Lieut. Col. A. V. KAUTZ, *15th Infantry,*
"Major THOMAS F. BARR, *Judge-Advocate,*
"Major GEORGE P. ANDREWS, *5th Artillery:*

"Pursuant to the act approved March 3rd, 1873, providing for the establishment of a military prison and for its government, the Secretary of War appoints you provisionally members of the board under section 2 of the act.

"You will observe that no appropriation has been made to carry out the act, and the board can, therefore, not be fully organized at this time.

"In order to save time, however, the Secretary desires you to visit several of the best-established State prisons and penitentiaries, to examine the plan of building and the system pursued for the reformation and dicipline of prisoners, mode of isolation, diet, labor, learning of trades, &c., with a view to your framing a system of regulations and being ready to report, whenever the board can be completely organized, upon a plan of buildings, embracing cells for confinement and isolation, workshops, &c., and upon whatever points may be of practical use in starting and maintaining the prison.

"The act, section 1, provides for locating a prison at Rock Island, Illinois. It is presumed the intention may have been to locate it on the public grounds belonging to the armory, near the town. The Secretary desires you to examine that locality as well as the vicinity of the town, and to report your views as to the expediency of maintaining a prison upon the armory-grounds, and its probable influence upon the interests of the armory.

"Copies of the act and of various reports upon military prisons are forwarded to Lieutenant-Colonel Kautz, who, as senior member, will act as president of the provisional board.

"A copy of Special Orders No. 109, May 31st, 1873, from this office is herewith inclosed, to enable you to draw mileage for your authorized journeys.

"I am, very respectfully, your obedient servant,

(Sgd.) "E. D. TOWNSEND,
"*Adjutant-General.*"

[Special Orders No. 134, A. G. O., 1873.]

"WAR DEPARTMENT, ADJUTANT-GENERAL'S OFFICE,
"*Washington, July* , 1873.

[Extract.]

* * * * * * *

"6. Lieut. Col. A. V. Kautz, Fifteenth Infantry, is relieved from duty on the board appointed by Special Orders No. 109, May 31st, 1873, from this office, and Col. N. A. Miles, Fifth Infantry, is detailed in his stead.

"By order of the Secretary of War:

(Sgd.) "THOMAS M. VINCENT,
"*Assistant-Adjt. Genl.*"

In pursuance of the foregoing order of May 31st, 1873, the board visited Rock Island n August of the same year, and examined the armory and arsenal grounds for the de-

termination of the questions stated in the order. In response to verbal inquiries, and at the request of the board, the following paper was prepared and sent to the president of the board:

"ROCK ISLAND ARSENAL,
"*August 15th*, 1873.

"To Colonel N. A. MILES:

"In reply to your inquiries respecting the selection of this arsenal as a site for a military prison, I have the honor to inclose herewith a copy of a communication on this subject, written by me to the Chief of Ordnance last winter.

"I would state, respecting this letter, that it was written in great haste, while I was in Washington, and that I was not able to give that careful thought to the subject which it demanded, and I regret that I am to-day so pressed with business that I cannot give such a full reply to your inquiries as I wish. I hope I may write to you more fully on this subject hereafter.

"I inclose herewith a map of the arsenal grounds, on which are shown the location of buildings and works completed, in process of erection, and for which plans have been fully matured and adopted.

"I would state, respecting the gun-foundery, powder-works, and tanneries, that plans for these works have not been fully matured and adopted, and I only show the sites selected for them.

"The island was procured by the Ordnance Department as a site for a great national armory and arsenal at a cost of nearly $300,000.

"The arguments which induced Congress to remove all property-holders from the island and to make appropriations for the purchase of lands and rights and privileges of such holders, and the legislation on these subjects and the action taken on these questions by the board of commissioners, of which Gen. Schofield was president, (from Jan'y 11th to Feb'ry 4th, 1867,) and the subsequent approval of the action of the board by Congress, show clearly the necessity that the whole island should be occupied and held by the Ordnance Department before the great work should be commenced, and particularly that the seclusion necessary for the great work for which it has been set aside could only be obtained by occupying the entire island.

"Your careful examination and consideration of the subject will show you that the plans for the arsenal and armory have not yet been fully made; so far as they have gone they have been carefully made to admit of future extension. And certainly, in the future growth of the nation, the establishment must and will be from time to time enlarged and expanded; and if any establishment were admitted which is antagonistic to the general plan, or which interferes with objects for which the island has been set aside, it would have to be removed.

"More than one-half the land of this island is not available for building purposes, being too low, and liable to overflow; and it does not seem that it is more than sufficient for or equal to the wants of the object for which it has been set aside, even for the plans as far as they have extended now. This is shown by the accompanying map.

"If we look to the future of the establishment and to what its wants may be, and are guided by the growth and wants of national and private establishments in Europe, it should convince us that the whole island should be kept intact for the one object for which it has been set aside. I believe, however, that the principal loss and injury which would come to the country from an interference with the plans of the Government for the island, would be the introduction of something antagonistic to the perfection of the arsenal and armory, and a consequent crippling of a plan upon which so much careful thought, study, legislation, labor, and money have been already expended, and a serious injury to a national establishment of which the nation should be truly proud.

"I would respectfully request that you consider carefully this bearing of the question, as I believe it to be most important.

"Admitting the interest the service has in securing a military prison, it appears to me that the service is still more interested in selecting for its site some other place than this arsenal.

"I am, sir, &c., &c.,
(Sgd.) "D. W. FLAGLER.
"*Capt. of Ordnance, Bvt. Lieut. Col., Commanding.*"

The following extract is copied from the report of the preliminary board, consisting of Army officers, appointed to visit State penitentiaries and prisons, and also to examine Rock Island for a site for the proposed prison:

"The board visited Rock Island, in the Mississippi River, with a view to the consideration of the question submitted in the letter of instructions. A topographical examination established the fact that there are but two points on the island where a sufficient drainage can be obtained—a want of very first importance. One of these is at a point near the principal entrance to the armory-grounds, lying in full view of the cities of

Davenport, Iowa, and Rock Island City, Illinois, and between buildings already erected for the purposes of the armory.

"As the safe-keeping of the prisoners would necessitate the inclosing of the prison-buildings within a high wall, it is thought that their erection at this point would be a blemish to their surroundings. The other point is more remote, and is a desirable one for the purpose, should it be finally decided to select any part of the island.

"The points above referred to are indicated on the map of Rock Island, herewith submitted, by numbered flags; the one first referred to being numbered one and the other two.

"As to the probable influence upon the interests of the armory, the board are of opinion that the erection of prison-buildings on the island at all would be extremely detrimental, interfering, as it necessarily would, with the carrying out to fulfillment of the elaborate and comprehensive designs which have thus far governed in the work which has been carried forward there. For instance, the point thought to be the only one at which a prison should, with due regard to good taste, be erected, is the one, as will be seen by the map, where the plans for the completion of the armory, as originally adopted, contemplate the establishment of a foundery for heavy ordnance.

"From the generous appropriations heretofore made by Congress for the gradual construction of the buildings held necessary to constitute the island what the plans referred to provide to make it, it is inferred that it has become the settled policy of the Government to continue the work to the end. Looking, then, to the not far distant future, it would seem unwise to erect buildings now for a permanent purpose which in the course of a few years would have to be removed.

"The fact of this property being an island does not add in any degree to its security as a place of imprisonment. In winter the river on either side is frozen over, and in summer it is easily fordable. A high wall would, therefore, be as necessary around the prison as though it were on the main-land.

"In the vicinity of Rock Island City, and on the high and desirable land near Rock River, a site can be purchased at from four to five hundred dollars per acre, and as twenty acres is thought to be all the ground necessary, the slight saving to be effected by the use of land on the island cannot be held of much weight against the attendant probable injury.

"Although not called upon to offer any suggestions as to the advisability of selecting any other site than the one indicated in the act of March 3, 1873, the board, in view of the fact that the armory at Rock Island promises to answer for furnishment with material of all the western portion of the country, would most respectfully suggest that the arsenal grounds at Fort Leavenworth, Kansas, would be a far more eligible and convenient location for a prison than Rock Island, while the buildings, now of but little practical use to the Government, could be readily converted to prison uses.

"Indeed it is believed that for one-third of the sum which will be necessary to properly construct entirely new buildings, those indicated may be made into buildings of a model character and surrounded by the requisite wall.

"The cost of supporting the prisoners would be fully as small at Fort Leavenworth as at Rock Island, and it is believed that even should it not be considered proper to appropriate the arsenal grounds and buildings for the purpose, some other portion of the Government reservation at that point should be taken."

* * * * * * *

The preliminary board on military prisons, appointed in the foregoing orders, was dissolved in October, 1873, and a new board appointed. Colonel Miles, 5th Infantry, who was president of the old board, was also president of the new board. Under date of December 5, 1873, the Secretary of War transmitted to Congress a report on the subject of military prisons, embodying therein the foregoing letters and reports of the preliminary board, and says therein:

"In regard to the island of Rock Island as a site, attention is particularly invited to the remarks of the board. On Rock Island, owned by the Government, there are but two sites where drainage, absolutely necessary, can be had. Either of these sites would materially interfere with and mar the plan for the armory. The idea of the location of the prison near the armory, in order that the labor of its inmates might be utilized, is not feasible. The most profitable labor of prisoners would be upon clothing, shoes, wagons, &c., while the various branches of the armory-work would have to be performed systematically by skilled artisans.

"The military reservation at Fort Leavenworth, Kansas, possesses every advantage possible over every other locality. The ground is already owned by the Government. It is the grand center of military transportation, from which rail-communication radiates to all parts of the United States. It is a military post, and the necessary details for prison-guards, &c., can be made most conveniently at that point. In regard to economy in constructing and maintaining the prison, it certainly possesses superior advantages. In this connection attention is invited to a communication dated Feb-

rnary 13, 1873, written before the passage of the act to establish a military prison, by Captain D. W. Flagler, commanding Rock Island arsenal."

Finally the military prison was located at Fort Leavenworth, Kansas, by the following act of Congress:

"CHAP. 186.—AN ACT to amend an act entitled 'An act to provide for the establishment of a military prison, and for its government, approved March third, eighteen hundred and seventy-three.'

"*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That said act be, and the same is hereby, so amended that all acts and things therein required to be done and performed at Rock Island, in the State of Illinois, shall be done and performed on the military reservation at Fort Leavenworth, in the State of Kansas: *Provided*, That the Government buildings now on said military reservation at Fort Leavenworth shall be modified and used, so far as practicable, for the purposes of said prison."

Approved, May 21, 1874.

CHAPTER IX.

THE ROCK ISLAND BRIDGE FROM 1872 TO 1876.

Brief of contents of this chapter and of previous history of the bridge—Description of bridge and different names given it—Date of completion of bridge—Apprehensions that the bridge would not be made a free highway for the public—Authority of Congress deemed necessary—Opinion of Chief of Ordnance—Fort Armstrong avenue, plans for and building of—Conflicting interests respecting the bridge—Rights of the Chicago and Rock Island Railroad Company—Importance to United States of having other railroads cross the bridge—Applications to have the bridge made a free highway—Indorsements on same by commanding officer of the arsenal—Letter from Chief of Engineers and indorsements thereon—Account of throwing open bridge for public use—Regulations for bridge—Remarks—Ferry Company's letter to Secretary of War and indorsements thereon—Regulation respecting railroad-freights—Correspondence with officers of Peoria and Rock Island Railroad Company—Difficulties attending regulation about railroad freights—Application from Davenport and Saint Paul Railroad Company for authority to build a railroad-bridge from Rock Island (city) to the island—Correspondence about same—Bill before Congress—Act passed—Remarks—Bridge not built—Correspondence respecting removal of old railroad-bridge and piers, and embankment across the island—Correspondence respecting retention of north pier of old bridge across main channel—Retention of pier ordered by Secretary of War—Correspondence respecting removal of embankment and piers in the south channel—Work completed in June, 1876—Horse-railways on the bridge—Bill for horse-railway introduced in the United States Senate by Senator Harlan, of Iowa—Indorsement thereon by Captain Flagler—House of Representatives bill No. 765 of Forty-first Congress—Various other propositions for constructing horse-railways on the bridge—Legal opinions of Hon. James T. Lane, United States attorney—Correspondence respecting the same—House of Representatives bill No. 391 for horse-railways—Correspondence respecting the same—Telegraph-lines on the bridge—Iron tower erected on the draw by the Western Union Telegraph Company—Case of United States vs. William Boehme for misdemeanor on the bridge—Arguments of counsel—Case never decided—Davenport and Saint Paul Railroad Company runs its track across the bridge approach—Application for writ of injunction—Correspondence respecting the same—Case reported to Chief of Ordnance—Various ordinances of city council of Davenport bearing on this case—History of the case—Injunction refused—No evidence found that right to occupy ground for building approach was ever granted to the United States—Appropriation for repairs and alteration of bridge—Difficulty arising from the wording of the appropriation act—Correspondence respecting the same—Account of the repairs made contained in annual reports—Bridge statistics.

As stated in Chapter V, the Rock Island bridge was completed and turned over to the Ordnance Department in February, 1873.

In this chapter will be given a history of matters relating to the bridge from the time it was turned over down to the present time, (December, 1876,) and also some action that was taken respecting the bridge by the Ordnance Department just prior to its being turned over.

In Chapters III, IV, V, and VII there has been given an account of all matters preceding and relating to the construction of the bridge, and

copies in full of all acts and resolutions of Congress relating in any way to the bridge, and also a copy in full of the guarantee between the Chicago, Rock Island and Pacific Railroad Company and the United States for the removal of the old railroad bridges and track across the island, and for the building of the new bridge.

For an understanding of the subsequent history of the bridge and interests belonging to it, frequent reference to these acts of Congress and the guarantee mentioned must be had. The names of the bridge or bridges used in these acts and other papers are somewhat confusing, and for convenience some explanation is necessary.

In the acts of Congress, in the guarantee, and in most papers of a date prior to 1873, the "Rock Island Bridge" (see map on Plate VI) means the railroad and wagon bridge connecting the island with Davenport, Iowa, the railroad-bridge connecting the island with Rock Island, (city,) Ill., and sometimes, also, the railroad and embankment on the island, all included in one, and this is properly its legal meaning.

In the papers of dates subsequent to 1873, the term "Rock Island bridge" is rarely used to mean all, without this explanation, because it would seriously mislead persons not very familiar with the arsenal bridges and their history. The part of the Rock Island bridge between the island and Davenport has sometimes been improperly called the "Rock Island bridge," but in most papers it is called the bridge over the main or north channel, the bridge to Davenport, or the Davenport bridge; the bridge over the south channel is generally called the railroad-bridge over the south channel, or to Rock Island, (city.) There is also shown on the map another important arsenal-bridge, viz, the wagon-bridge to Rock Island (city) described in Chapter VII, and generally called the Rock Island wagon-bridge. A sufficient examination of the map to learn the position and uses of these bridges will, I think, prevent any misunderstanding of names used in papers on this subject. It must be borne in mind, however, that the "Rock Island Bridge" is a name fixed by acts of Congress, and means, in official documents, all that it is described to include above, but has nothing to do with the "Rock Island wagon-bridge."

The "Rock Island wagon-bridge," the bridge between the island and Davenport, and the Arsenal avenue (see Fort Armstrong avenue on the map) connecting the two bridges, have been used by the cities on the two shores for free transit across the river since 1872.

It is a very desirable and important privilege, and the pecuniary advantage that the cities and community derive from it is so great, compared with the loss to the Government involved, that it is natural and right, and very desirable, that the privilege should be granted.

The Rock Island wagon-bridge was completed (see Chapter VII) in 1869, and has been in full use for arsenal purposes ever since. The other bridge, between the island and Davenport, was not so far completed that wagons could use it until the fall of 1872. As the latter approached completion, some fears were felt lest the privilege of using the bridges and Arsenal avenue as a free highway between the cities might not be granted, and it was a matter of such high importance to the cities and community that it excited much interest and some bitter feeling. On this account, and because there are still some matters in regard to it that are not very satisfactorily settled and may cause it to become a subject for consideration hereafter, I think a full account of it should be given.

None of the acts of Congress contemplated the free use of the bridge or bridges described, but all the acts creating the bridges and making appropriations for their construction, specified, especially, that they were

for the use of the Government in its occupation of the island for military purposes.

In conversation with members of Congress from this section who have been mainly instrumental in procuring the passage of the acts referred to, and who were themselves very anxious that the bridges should be used by the public, free of cost, they stated that provision for such a privilege was carefully kept out of all the bills when before Congress, as it would have prevented their passage. This only made the responsibility of opening the bridges for the use of the public the greater, because, so far as it indicated anything, it indicated that Congress had intended that they should not be so used.

To prevent future controversy and injury to the interests of the arsenal, I was anxious that the matter should be laid before Congress and its sanction for the use of the bridges for private purposes obtained, and therefore recommended this. I also deemed it of the highest importance that some action should be taken by Congress to provide regulations having the force of law for maintaining order and safety on the bridge.

It was generally believed by the citizens of the cities that the Government, in building the bridges, had intended that they might be used as a free highway to connect the cities, and that the commanding officer of the arsenal had authority to permit them to be so used. It placed him in the unfortunate and not uncommon position of having law and the interests of the Government to regard on one side, and a desire to grant a desirable privilege to the community on the other.

When the Chief of Ordnance, Brig. Gen. A. B. Dyer, visited the arsenal in the fall of 1871, I told him that it was generally believed that the bridges and the island were to be a free highway between the two sides of the river, and asked him for instructions. He gave no instructions, but said it was an unfortunate, troublesome matter, and that the privilege could not be granted without authority of Congress. I believed that the privilege would be granted certainly some time, and in the following winter made plans for an avenue across the island (Fort Armstrong avenue) for the use of the public only, and for which no provision had been made in the construction of the bridges, and the same winter took those plans to Washington, in connection with other plans for the Arsenal Railroad.

The Chief of Ordnance was sick and could not attend to business, but the plans were discussed with his principal assistant, then in charge of the office and now Chief of Ordnance, and they were verbally approved by him, but no decision of the question about the use of the bridges by the public was obtained.

In the following summer, (1872,) as soon as the appropriations for the arsenal were available, I commenced work on the avenue in order to have it finished as soon as the bridge to Davenport should be completed. The appropriation for the arsenal that could be used for roads was small, and this work had to be done at the expense and with the neglect of other very desirable and important work.

The bridge to Davenport was still in the hands of the Engineer Department, not completed, and the community anxious to use it. It was then that the fear arose that it might not be made a highway, and there was much dissatisfaction on the subject. The subject was much discussed in the newspapers in the two cities, and sometimes with considerable bitterness. Persons opposed to the administration in politics took advantage of the sensitive feeling of the community on the subject, and improved the opportunity by claiming that the administration was opposed to having the bridge made a highway. This was manifestly

unfair, because all concerned in the matter were anxious that the privilege should be granted, and were doing what they could to obtain it. There were some other conflicting interests to trouble the question. The Chicago, Rock Island and Pacific Railroad Company had helped to pay for the bridge, and they had thereby purchased at much expense a right of way across it and the island; but the acts of Congress and the railroad company's guarantee granted the same right of way to other railroad companies upon their paying their share of the cost. If the wagon-road on the bridges became a highway, then other companies could use it for freighting across the river on wagons, and thereby avoid the necessity of paying for a right of way. This was manifestly unfair to the Chicago, Rock Island and Pacific Railroad Company. It would be using the bridge that that company had helped to pay for to aid its competitors, and save them from sharing the cost of a right of way. (Although pertinent to the question indirectly only, it should be stated here that the United States has no more important interest in the bridge than its railroad interest, and to provide for having all railroad companies run their cars across the bridge and island that desire to do so. Every railroad company that acquires this right of way thereby makes its road to connect directly with the Arsenal railroad, which is now built, and which connects with the railroad across the island. The Government cannot connect with any company's road that does not acquire this right of way except by passing over the road of another company or companies; that is, the company or companies that *do* have the right of way across the island. If, then, but one company holds the right of way across the island, the Government cannot receive or ship freights by any other road except by permission of that company or by hauling its freight in wagons from the arsenal buildings to the depots in the cities, a distance of from 1½ to 2½ miles. I know of nothing in connection with the bridge of more importance to the United States than the avoidance of this monopoly, and anything that would tend to prevent the railroad companies from procuring this right of way is in direct opposition to one of the most important interests of the Government.)

This subject will be discussed more fully in connection with other matters relating to the bridge.

A ferry company connecting the two cities had a charter compelling them to maintain the ferry in a certain manner, and in return prohibiting any other ferry between the cities. This company claimed that the free use of the bridges would, and did, after the use of the bridges was made free, interfere seriously and improperly with their business; that under their charter they had to maintain the ferry, and that the opposition of the Government did not leave them sufficient business to make it remunerative. Also, during the fall of 1872 and the subsequent winter, there were several applications for the privilege of running horse railroads across the bridges and the island. The interests of some of these were conflicting, and opposed by outside parties.

Several petitions and letters urging that the bridges should be made free to the public, and letters and papers on the other subjects mentioned, were sent from citizens in the community to the Secretary of War in the fall of 1872, and were referred here for report. Some of these state more fully matters relating to the bridge than I have done above, and are as follows:

On the 27th of September, 1872, the Chief of Ordnance referred to me for report certain papers relative to the opening of the Rock Island bridge, as follows: "A petition signed by the mayor and aldermen of

the city of Davenport, Iowa, to the Secretary of War, that the bridge be opened for the use of the public," in which they state that they are advised that the Secretary of War has ample power to do this without further legislation.

This petition was forwarded to the Secretary of War under date of August 7, 1872, by Grant & Smith, attorneys, Davenport, Iowa.

Also, as extract from a letter from William Allen to the Secretary of War, dated August 9, 1872, as follows:

I merely wish to say to you and the President that there is great and increasing dissatisfaction among the people of Davenport and Rock Island at the delay in opening to the public the Government bridge between the two cities. It has been completed some three or four months, and no one is permitted to use it without a pass from the commanding officer.

On the 1st of October, 1872, I reported to the Chief of Ordnance on these papers as follows:

The papers referred to me by you on the 27th of September for report are respectfully returned herewith.

Respecting the building of the avenue to connect the two bridges which connect this arsenal with the cities of Rock Island and Davenport, I have to state that work upon the same has progressed as rapidly as economy would permit. Funds were not available till the latter part of July, and some time was required for the work.

The avenue is 1,130 feet long, 50 feet wide, and is being paved with 10 inches of finely-broken rock, and is to be covered with gravel. Some of the excavation for grading had to be made through rock.

It was necessary that the avenue should be built in a substantial manner. Delays have been caused by temporary buildings, used by the Engineer Department, standing in the way, which I could not remove, and in obtaining such a construction of the arsenal approach to the bridge as would permit a connection of the arsenal avenues therewith. Other means of crossing the arsenal from one bridge to the other have been provided in the mean time, and I have seen no reason for hastening the work more than has been done.

The difficulty in obtaining laborers has, at times, required that all my force should be employed upon other much more important work.

If it is necessary, I can complete the building of the avenue in two weeks.

Respecting the propriety of "opening the bridge to the public," as requested by the common council of Davenport, I have to report as follows:

By "opening the bridge to the public" is meant that the bridge connecting the arsenal with the city of Davenport, and the bridge connecting the arsenal with Rock Island, and the avenue across the arsenal, shall be made a public highway. It is true, as is claimed, that this would be a convenience, and directly a benefit to the two cities, but to do so without any limitation or restriction, I believe, would be impolitic and wrong, because it would injure somewhat the interests of the Government, and, in that way, indirectly the interests of the towns, which are greatly interested in the carrying out the plans of the Government at this arsenal.

Some of the objections to making this bridge a highway are as follows:

The acts of Congress authorizing the building of the bridges, and making appropriations therefor, state that the bridges are to be for the transaction of the Government business at this arsenal. It does not appear from the several acts that the bridges were intended for any other purpose, or for a public highway, as is claimed in the petition of the common council of Davenport. I should therefore think that authority for making the bridges a public highway would have to be obtained from Congress, especially if such use of the bridges should interfere with their use for the purposes for which they were intended.

Respecting a greater freedom in the use of the arsenal bridges and avenues as a means of transit between Rock Island and Davenport, I will state that I believe that, by meeting the city councils and citizens of the towns and explaining the subjects discussed in this report to them, such arrangements can be made for the use of the bridges as will be not only satisfactory to people desiring to use the bridges, but safe to the interests of the Government. It has been my intention to try to do this as soon as the bridge to Davenport should be turned over to the Ordnance Department. This bridge, although built for this arsenal, and, as stated in one of the inclosed letters, completed some time ago, has not yet been turned over to the arsenal.

It has not, therefore, been in my power to take any action or make recommendations respecting the uses made of the bridge.

I believe a principal cause of dissatisfaction and complaint respecting the bridge has been that persons holding permanent permits to visit the arsenal by any bridge or

ferry could not do so until they had procured another permit to cross over this particular bridge.

I believe it to be of the very highest importance that the plans of the Government for this arsenal should be maintained. Much legislation, expense, and work have now been incurred, all tending to the carrying out of a great plan.

If rights already established are given away piecemeal, because they appear not to be of vital importance, the plans will be interfered with and injured greatly, and the great work attempted will be, in a measure, a failure.

I have had no object in writing this report except to defend the interests of the United States, and will certainly, at all times, do all in my power to benefit the community surrounding the arsenal.

On the 27th of September, 1872, the Chief of Engineers wrote to Col. J. N. Macomb, (then in charge of the construction of the bridge between the island and Davenport,) and stated that the Secretary of War had informed him that the arsenal avenue between the two bridges would be completed at an early day, and asked if the bridge (the bridge to Davenport) could not be opened for use at the same time.

On the 5th of October, 1872, Colonel Macomb referred this communication to me, with an indorsement stating that he thought the following should be excluded from passing over the bridge:

Hay, cattle, barrel-wagons with racks, barrels of gunpower and other explosives, and such other things as may be determined to be objectionable. Under the circumstances he is of the opinion that the bridge could be thrown open, under proper restrictions, without detriment to the public service.

This paper was returned by me with the following indorsement:

Respectfully returned to Colonel Macomb. Throwing the bridge to this arsenal and the avenues across the west end of the arsenal open to the public, as projected in the inclosed letter, can only mean making them public highways. As the acts of Congress authorizing the construction of the bridge to Davenport, and the acts making appropriations for building the same, as well as for the other bridge and avenue, state that they are for the transaction of the Government business of this arsenal, it would seem that authority to make them a public highway should come from Congress. I should be glad, and would do all in my power to relinquish them to the use of the public so far as it could be done without injury to public property, and without interfering with the business for which the bridges were built.

I wrote a long letter last week to the Chief of Ordnance setting forth my views on this point. I suppose the letter has been referred to the Secretary of War. I believe all the restrictions on the use of the bridge that you suggest would be absolutely necessary, but I also think that others would be absolutely necessary for the protection of the property and interests of the Government. If necessary, I could push the avenue across the arsenal to completion in two weeks. Until it is completed it could not be used.

About the 18th of November, 1872, the ice-blockade in the river began and the ferry could not be used. As usual at this season of the year, there could then be no traffic across the river, except by the railroad, until the ice should be strong enough to bear crossing on it. I believed that authority for the public to use the bridges would be granted very soon, and as the accommodation would be so great while the ferry was not running, I conferred with Colonel Macomb, then in charge of the bridge between Davenport and the island, on the subject, and he consented to open that bridge for use. I then, on the 19th, opened for use by the public the Rock Island wagon-bridge and the avenue across the island.

On the 25th of November the following telegrams were received and sent:*

* At this time the present Chief of Ordnance, General S. V. Benét, was principal assistant to the Chief of Ordnance and in charge of the Ordnance Office, and the action indicated in the telegrams was taken by him. The Chief of Ordnance, General Dyer, had been ill and absent from the office nearly two years.

The Chief of Ordnance to Captain Flagler.

Throw open at once to public travel the roadway across the island and the bridge to Rock Island during continuance of ice-blockade, under such regulations as are necessary for the protection of public interests.

Captain Flagler to the Chief of Ordnance.

Telegram respecting bridge received.
I opened the bridge and road, under restrictions imposed by your telegram, excepting heavy loads, on the 19th instant.

Under date of November 30, 1872, the Chief of Ordnance telegraphed as follows:

Telegram received. The Secretary of War approves your action, and directs that the road and bridge to Rock Island be kept open to travel, except for live-stock, hay, straw, and such wide loads as cannot pass on new bridge, without reference to ice-blockade. Every accommodation that will not prejudice public interests to be given, night and day.

From the above date, November 30, 1872, to the present time, the bridges have been open to the public, except for driving live-stock and hauling certain wide loads and combustible materials; and excepting, also, from a subsequent date, the hauling of certain railroad-freights.

In March, 1873, I received instructions from the Chief of Ordnance to prepare, and send to him for action, such regulations for the use of the bridges by the public as were deemed necessary.

A list of regulations was prepared and sent, and, with one or two additional regulations added by the Chief of Ordnance, were subsequently approved by the Secretary of War.

These regulations are as follows:

1. The jurisdiction of the United States extends over the bridges and island from shore to shore, and all travel and traffic over the same must be subordinate to the rights of the United States.
2. Loads of hay, straw, or other material of such a bulk as to interfere with the passage of other vehicles or pedestrians in any way, or which might injure the superstructure, will not be allowed to enter upon or cross the bridge at any time.
3. Droves of live-stock will not be allowed to enter upon the bridge.
4. Explosives and other articles which might injure the bridge, persons, vehicles, or traffic shall not be brought upon or taken across the bridge, except in the service of the United States.
5. No processions, except funerals, nor military organizations of any kind shall be allowed to come upon or cross the bridge, except by previous special consent of the commanding officer of the Rock Island arsenal, and any body of men in crossing will invariably break step.
6. Crowds of people are prohibited from collecting on the bridges.
7. No person is allowed to fish from the bridges.
8. No person, except officers and guards in discharge of their duty, are allowed to obstruct or in any way interfere with the passage of persons or vehicles over the bridges.
9. No persons, except officers and guards in the performance of their duty, are allowed to discharge fire-arms from the bridges.
10. All drunken and disorderly persons and loiterers shall be kept off the bridges.
11. No person is allowed to drive, ride, or lead any animal faster than a walk while on the bridges.
12. Any person who shall by carelessness cause any defacement or injury to the bridges shall thereafter be excluded from the use of the same; and any person who shall maliciously cause any such defacement or injury shall, in addition, be punished to the extent of the law.
13. No interference with or obstruction of workmen on the bridges will be permitted, and any person who shall assault, resist, or abuse the guards on the bridges for or while in the discharge of their duty, beside being punished to the extent of the law, shall thereafter be excluded from the bridges.
14. The use of the bridges by the public may be temporarily restricted or suspended at any time by the commanding officer of Rock Island arsenal when necessary repairs or the interests of the public service may demand it.

15. The commanding officer of Rock Island arsenal shall enforce these regulations at all times, and is empowered to exclude from the use of the bridges at his discretion all persons who shall violate any of them.

16. Persons who shall commit crimes on the bridges or on the arsenal-grounds, or acts in violation of the necessary regulations of the post, will be arrested and confined in the arsenal guard-house until they shall be properly discharged or delivered into the custody of the officers of the civil law.

The following remarks are taken from a great deal of correspondence on subjects relating to the bridge, and give my present views, gained by experience, respecting it. The wagon-way on the bridge to Davenport is 1,540 feet long, rather narrow for a double road, (16½ feet in the clear,) obstructed by a draw, necessitating detentions and crowding of vehicles.

It is not well adapted for use as a general highway. In its general use by the public, I believed that certain vehicles and loads that would endanger the safety of vehicles or frighten animals would have to be prohibited from crossing, and recommended this. Certainly, loads of hay and straw, loads too wide, and driven live-stock, would have to be kept off.

The question of government or of police regulations on the bridge was one respecting which I had most anxiety. It has been less troublesome than I anticipated; still it must always be a source of much trouble, and of some responsibility to the commanding officer of the arsenal. Upon first thought this will not appear, but it should be remembered that, generally, bridges are under the control of municipal, town, or county authorities. In such cases, ordinances to regulate details exactly applicable to them are passed and become laws. For any violation of the law, offenders can be taken at once before a justice and fined.

This is simple, easy, effective, and satisfactory. On the Government bridges and arsenal-grounds nothing of the kind is practicable. The only laws in force are the laws of the United States, and these take no cognizance of disorderly conduct, drunkenness, resisting the guards, committing nuisance, fast driving, &c. There is, then, no means of government left, except force, which is very disagreeable and ineffective, involves serious responsibility, and provokes hatred and dissatisfaction. It should be remembered that the route across the bridges and arsenal is more than half a mile long, part of the way through the long, narrow bridge described, with a draw, and a much-used railroad overhead, and the rest of the way close beside the railroad and along a narrow causeway to and across another bridge, with railroad-crossings on the bridge-approaches. All this route is filled with the busy traffic between two large and growing cities. It is certainly troublesome to maintain such order as will insure safety and comfort.

Space has been given to this subject, because I believe the matter should be laid before Congress, and must be eventually, and some action obtained insuring to the public the right to use the bridge, stating to what extent it may be used, making some more permanent provision for its care, preservation, and repair than uncertain annual appropriations by Congress, and giving the force of law to necessary regulations for maintaining order and prescribing the method of enforcing them. It is but fair that the commanding officer of the arsenal should be relieved from the responsibility of the present state of affairs.

A question has arisen involving the jurisdiction of the United States over the part of the bridge between the middle of the main channel and the Davenport shore, which has not been satisfactorily settled, and another case involving the right of the United States to occupy and hold the Davenport approach to the bridge. Both of these are sufficiently described in the papers pertaining to them, which will be quoted

further on in this chapter, but being pertinent to the subject are mentioned here.

After the bridge had been opened for the use of the public, in May, 1873, the ferry company, heretofore referred to, made application for relief from the injury done them by the United States, and the following correspondence occurred:

On the 10th of May, 1873, Messrs. Spencer & Robinson, of Rock Island, addressed the Secretary of War as follows:

We would respectfully represent that we are the proprietors and owners of the ferry between Rock Island, Ill., and Davenport, Iowa; that we received our franchise on the Illinois side by charter from the State of Illinois granting us the *exclusive right* to transport passengers and teams from the city of Rock Island to Davenport until the year 1881. On the Iowa side we are the riparian owners of two miles of river front, as will be more fully explained by a letter from Judge Grant inclosed herein; and have a license from the county court of Scott County, Iowa, granting us the *exclusive right* to transport passengers and teams, &c., from the city of Davenport to Rock Island, and have filed our bonds, with approved security, to keep on hand at all times during the day good and sufficient boats, well manned, for the safe and convenient passage of all persons, teams, &c., that may desire to cross the river at this point.

Under the present regulations of the Ordnance Department, opening the bridge free to the public, excluding only loads of hay, straw, combustible material, and stock, the ferry is compelled to run for the accommodation of the public at a loss, the receipts not being equal to the running expenses.

Omnibuses and hackney-coaches are carrying passengers in competition with the ferry, which under the laws of Illinois and Iowa they could not do, except by express permission of the Ordnance Department to cross the bridge. A large majority of the footmen cross on the ferry, but they, with such loads as are inhibited from crossing the bridge, and stock, are not sufficient to compensate for running the ferry. We therefore submit the question to your careful consideration, and respectfully ask that you cause the bridge regulations to be so modified as to permit any and everything to cross, and relieve the ferry from duty, or that you so restrict the crossing on the bridge that a reasonable support may be left for the ferry.

The letter of Judge Grant to Messrs. Spencer & Robinson:

In reply to your inquiry I think the United States has committed a great injustice to the ferry company by the manner and extent in which the bridge across the island is opened to the public use. The regulations exclude only hay and straw teams and stock from its use, and the ferry company is thus compelled to keep their boats running to accommodate this small part of the business, and it must be done at a loss.

There ought to be some remedy for this; either allow everything to go over the bridge or exclude enough to pay the ferry company for accommodating the public.

In the early history of the ferry company, the Territory of Wisconsin granted to the then owner, A. Le Claire, before any town was laid out, the exclusive right of the river-bank where the bridge stands on the Iowa side in fee-simple, and this right in fee-simple was sold by Le Claire as early as 1835 to John Wilson, and it has continued from that time until now in the possession of Wilson's heirs and assignees, the present owners. The United States has made no compensation for this right. It had parted with the riparian right in 1833 by grant to Le Claire, and the owners have never been paid for this right by the United States, and their right to compensation in some form is eminently just.

On May 15, 1873, the Chief of Ordnance referred the letter of Spencer & Robinson and inclosure to me for report.

On May 19, 1873, I returned to the Chief of Ordnance the foregoing papers, with the following report:

I have the honor to return herewith Messrs. Spencer & Robinson's letter, with inclosed letter respecting the Rock Island bridge.

I believe all the statements made in these letters to be true. The important statement to the United States is, however, that the cost of running the ferry is less than the receipts of the company, which indicates that the ferry may be closed. The difficulties encountered by the company were foreseen and fully discussed in my report on this subject made to you October 1, 1872.

It is impossible that wide loads and live-stock should be allowed to cross the bridge. The necessity for excluding wide loads is apparent. The necessity for excluding live-stock is equally great, though not so apparent. Live-stock is not excluded only because it injures the bridge. A consideration of the length and narrowness of the

bridge to Davenport will show that live-stock cannot be admitted to the bridge with safety to vehicles. The danger would be less on Fort Armstrong avenue and the bridge to Rock Island, but much greater on the long causeway leading from the island to the latter bridge, where the cars on the near and elevated railroad-track frighten animals, and the danger of going over the banks is imminent. It is not proper to consider the propriety of closing the bridge to other traffic while live-stock crosses, because, on account of the great distance, a small drove of say a dozen might get over in 15 minutes, and a drove of 50, if interfered with by the draw, would require probably ¾ of an hour, and this closing might occur several times a day. Therefore, it is improper and impracticable that wide loads and live-stock should cross on the bridges; and on this account the maintenance of the ferry is of importance to the Government; for without it no crossing is provided for this class of traffic, and we would be harassed by applications to admit such traffic, and condemned for not admitting it, when the opening of the bridge has broken up the ferry and prevented it from crossing elsewhere. The maintenance of the ferry is important to the cities for this reason and for others. If it is determined to restrict in any way traffic across the bridges, I only recommend that the restrictions apply to the running of hacks and omnibuses for carrying passengers, and the hauling of freights between railroad-lines. Such a restriction would bear hardly on none, and would, I believe, leave to the ferry enough business to support it. Respecting the use of the wagon-bridge for carrying railroad-freights, I have to state that a great advantage to the United States in building the bridge was that it provided a bridge-crossing to all railroads, and thereby a connection between the arsenal railroad and all the railroads that cross the bridges.

Allowing the railroad companies to haul their freights over the wagon-bridges tends to prevent them from paying for their right of way over the railroad-bridges, and thus we fail to connect with them, and must pay from $2 to $7 per car-load extra freight for all freights that come by any line except the Chicago, Rock Island and Pacific.

On May 26, 1873, the Chief of Ordnance returned to the Secretary of War all the foregoing papers, and recommended that for the reasons stated the bridge regulations be so modified as to prohibit railroad-freight from being hauled over the wagon-road of the bridge.

This was approved by the Secretary of War, and the Chief of Ordnance then returned the papers to the commanding officer of the arsenal for his information, and for the modification of the regulations as directed.

On the 18th of June, 1873, I returned the papers with proposed modifications of bridge regulations, and stated that the railroad companies in Rock Island and Davenport had been notified of the order.

THE PROPOSED MODIFICATION OF BRIDGE-REGULATIONS.

Railroad-freights, including freights shipped to and from points in Iowa over railroads in Illinois, and freights shipped to and from points in Illinois over railroads in Iowa, are not to be hauled over the wagon-roads of the bridges unless these freights are for the arsenal or the United States.

On the 23d of June, the Chief of Ordnance notified me that the proposed modification of bridge regulations had been approved by the Hon. Secretary of War.

On the 3d of December, 1873, William R. Hamilton, president Peoria and Rock Island Railroad Company, wrote to me and requested a copy of orders of the Secretary of War excluding railroad freights from the bridge, and said he thought the order bore heavily and unjustly on the road.

In reply to the above letter, under date of December 6, 1873, I wrote as follows to Mr. Hamilton:

I have the honor to acknowledge the receipt of your letter of the 3d instant. The regulation of the War Department referred to is as follows:

"Railroad freights, including freights shipped to and from points in Iowa over railroads in Illinois, and freights shipped to and from points in Illinois over railroads in Iowa are not to be hauled over wagon-roads of the bridges unless these freights are for the arsenal or the United States."

The reasons for making this regulation are as follows: The United States has

expended about one million dollars in constructing the bridges. The object of the expenditure was mainly to provide a railroad-crossing for all railroads, and thereby connect the arsenal railroad with all the roads, and the acts of Congress creating the bridge were framed especially to effect this—that is, to provide that all railroads may cross the bridge by the payment of a sum of money. Without this arrangement, to give us the use of all transportation-lines, it would be almost impossible for this arsenal to transact its business in time of war, or when running to its full capacity. Even now, with our limited business, I suffer severely from the monopoly one road has of our transportation. It is not easy for me to make a stone contract with a quarry off the line of one road. By constructing a free wagon-bridge and opening it to the railroads for the transportation of their freight, the Government would itself remove or diminish the necessity to the railroad companies for their acquiring a right of way over the bridge, and the Government would thereby deliberately defeat its own important object to its own great injury. In this respect I think the interests of the Government and of your company are identical; that is, that you should acquire the right of way over the bridge. Certainly, by constructing a wagon-bridge for its own uses, and declining to allow its free use by the railroads, the Government has worked no harm to the railroads, and leaves them in the same condition that they were in before. At the same time it is my personal wish to do anything in my power for your road, not merely because it would give me pleasure, but because your road is an important one to the interests of this arsenal, and you may be sure that this will always be done.

From the first this rule has caused some trouble. Some parties have always tried to avoid the rule, and would unload cars on either side of the river, and wagon freights over to avoid paying freight-charges across the bridge. The railroad companies who have not purchased a right of way across the bridge have been taking a considerable portion of their freights across by the ferry rather than pay car-toll across the bridge. During the ice-blockade in the fall and spring, when they could cross neither by ferry nor on the ice, they have been urgent to haul freights via the wagon-road on the bridges, and have sometimes done so.

Parties in Davenport have generally gone to the coal-yards in Rock Island to purchase coal, and have wagoned it across the bridge. This finally led to the general shipment of coal to Rock Island by rail and its transshipment by wagons across the wagon-road on the Government bridges. The railroad company complained, and some coal-dealers claimed that the use of the bridge by others interfered with their business, and it was stopped.

These conflicting interests respecting the use of the bridge make it a source of annoyance, and require the commanding officer of the arsenal to assume an unpleasant responsibility.

The following act of Congress and papers relating thereto have a direct bearing upon much of the foregoing matter:

In 1872 Congress passed an act to grant a right of way to the Davenport and Saint Paul Railroad Company across the bridge between the island and Davenport and the right to build another bridge from the island to Rock Island City.

The proposed site of the new bridge and line of railroad on the island are shown on the map on Plate VI.

The bridge has never been built; but the papers in the case are interesting, because they involve the question of the right of the United States to grant a right of way to railroad companies across the whole of the Rock Island bridge, and the important interest that the United States has in the matter, mentioned in another place in this chapter.

On the 16th of March, 1872, the Chief of Ordance referred to me for remarks the following communication from George H. Parker, a director of the Davenport and Saint Paul Railroad Company, to the Secretary of War:

The Davenport and Saint Paul Railroad Company, one of the western connections

of the Pennsylvania Central Railroad, now built, and occupying 110 miles northwest from here, with eastern connection via Peoria, has already or soon will make a formal application for a joint use of the Government railroad-bridge and right of way across the lower end of the island, below the present contemplated track of the Chicago, Rock Island and Pacific Railroad, diverging from that track a short distance east of the west bank of Rock Island, and running southwesterly, crossing the slough about 200 feet below the wagon-bridge to the island, and thus connecting with their eastern ally. I write at the request of Hon. George H. French, president, being a director and one of the executive committee of the Davenport and Saint Paul Railroad myself. We think that we can show conclusively that the interests of the Government will not be prejudiced by such a grant. If there has been any action had by you or your Department touching this matter, and of such a character as to affect the plans of the company as herein detailed, I should be pleased to hear from you on the subject.

This paper was returned with the following indorsement:

Respectfully returned to the Chief of Ordnance. The right of way over the Rock Island bridge asked for in this letter is already guaranteed by the several acts of Congress authorizing the construction of the bridge, and also by a guarantee given by the Chicago, Rock Island and Pacific Railroad Company, (see pages 253 and 254 report of Chief of Engineers, 1870.) Permission to construct a new bridge from the arsenal on Rock Island to the Illinois shore and also a track on the island of Rock Island would defeat the principal advantage maintained for the United States in all legislation touching the Rock Island bridge. Great trouble and a large expenditure of money have been incurred by the United States to provide a bridge at Rock Island. This bridge was intended to carry all railroads desiring to cross the river at that point, and thus prevent the building of more bridges to the island and tracks across it. It is very important to the interests of the United States that this point should be maintained. I am aware that on account of a claimed uncertainty in the acts above referred to, the Chicago, Rock Island and Pacific Railroad Company claims to own and control that part of the Rock Island bridge which is between the island and the Illinois shore, and also the track across the island; also, that making this claim, the same company now refuses to permit the other railroad company (the Davenport and St. Paul) to cross over the part of the bridge they claim to own. The Davenport and St. Paul Railroad Company therefore seeks for permission to build a new bridge to and a track across the island.

A bill (H. R. 1672) granting this privilege passed the House of Representatives on 13th inst. It is desired that this bill should be submitted to the War Department before being acted on in the Senate.

In considering this bill I think it very important that it should be permanently settled now whether the United States owns the whole bridge, and whether the War Department has now authority to grant a right of way to the Davenport and St. Paul Railroad Company over the whole Rock Island bridge from the Illinois to the Iowa shore.

It is my own opinion that the several acts of Congress on this subject certainly give this authority to the War Department, or to the United States, and it is evident that such was the intention of Congress. If this is so, then the bill now in Congress, referred to above, is an unnecessary one if, as I am informed by the president of the Davenport and St. Paul Railroad Company, he would prefer a right of way over the Rock Island bridge (now nearly completed) to building a new bridge, on account of the delay and great expense which must attend the latter plan.

This matter is highly important, not so much from the injury that this particular bridge would inflict upon the national armory and arsenal at Rock Island, as on account of the following reasons:

The Davenport and St. Paul Railroad Company have applied to the Chicago, Rock Island and Pacific Railroad Company for a right of way over the Rock Island bridge, as contemplated in the acts of Congress on this subject. This right of way has been refused, and the Chicago, Rock Island and Pacific Railroad Company state that they can, and will prevent the Davenport and St. Paul Company from running over that part of the bridge between the island and the Illinois shore, and the track across the island. If, on account of this refusal, Congress now passes a bill authorizing the building of a new bridge and track, it seems to give up the ownership and control of one part of the Rock Island bridge, a matter of the highest importance to ordnance interests at Rock Island, and one upon which so much legislation and money have already been expended, and thereby opens the door to the building of other railroads and bridges on and upon the island, which would be highly destructive to the important plans of the Government at that place. I would respectfully suggest that a legal decision be obtained as to whether sufficient authority to grant to railroads a right of way over the Rock Island bridge is now invested in the War Department or in the United States; and if it is not, then that additional legislation be requested from Congress giving this authority.

On the 18th of April, 1872, I wrote to the Chief of Ordnance as follows:

After I left the Ordnance Office, on the 9th inst., I went to see the Attorney-General, and Mr. McNally went with me. I explained fully to the Attorney-General my views relative to the Rock Island bridge, the objections to the passage of the House bill granting the privilege to build a new bridge, and the importance of having a decision *now;* that the United States does own the whole Rock Island bridge and can give a right of way over it to all railroad companies that will comply with the laws; and that the United States has power, as contemplated in the laws of Congress, to confine all railroads to the Rock Island bridge, and to prevent them from branching out over the island, thereby defeating the plans of the Government at this place.

Mr. Williams intimated that he agreed with me, but said that the Davenport and St. Paul Railroad Company were to come before him in a few days and argue their case. I requested Mr. McNally to talk with you about it, and thought it important that we should have an agent to represent us at the same time, and that Mr. De Caindry would be a good person to do it. I have had a long talk with the president of the Davenport and St. Paul Railroad Company since I came home, and his company will make a great effort to get their bill passed.

If they succeed it will do us much harm, and I think the subject of importance, not so much because if the bill is passed the United States thereby gives up a large amount of property, as because we thereby relinquish what was fought for so faithfully through several years of legislation and work by the Rock Island commissioners, viz, the confinement of all railroads to one line, and the preservation of the island for the purposes for which it has been set aside by the United States. I am perfectly satisfied now that the intention of Congress, and of all concerned in the framing of the laws, was what I stated it to be, (in my indorsement on a letter from Mr. Parker, attorney of the Davenport and St. Paul Railroad Company, referred to you by the Secretary of War, and by you referred to me while I was in Washington,) and that the Chicago, Rock Island and Pacific Railroad Company so understood it at the time, viz, that the United States should own the whole bridge and have the power to give a right of way to all railroads over the bridge if the railroad companies comply with the laws. To show the position that the Chicago, Rock Island and Pacific Railroad Company now occupy, I inclose herewith a copy of a letter from the superintendent of the company to the president of the Davenport and St. Paul Railroad Company.

If the Chicago, Rock Island and Pacific Railroad Company can maintain its position, it will give them a valuable monopoly of freights between the West and East, and I have no doubt that the company will make a strong effort to maintain it.

CHAPTER 288.—Approved June 4, 1872.—(Volume 17, page 220.)

AN ACT granting to the Davenport and Saint Paul Railroad Company the right of way.

That the Davenport and St. Paul Railroad Company, a corporation existing under the laws of the State of Iowa, be, and is hereby, authorized, upon the payment of one third of the cost of the bridge over the main channel of the Mississippi River at Rock Island, and shall also be liable for and pay one-third of the cost of keeping the same in repair, to pass the cars of the said Davenport and St. Paul Railroad Company over said bridge, with the same rights and privileges, and subject to the same restrictions, that are or may be exercised or enjoyed by any other railroad company.

SECTION 2. That upon the payment into the Treasury of the United States of one half of the money referred to in section one of this act, and the payment to the Chicago, Rock Island and Pacific Railroad Company of the remaining half of said sum of money, said Davenport and St. Paul Railroad Company shall be authorized to construct and maintain its own track and bridge from the east end of the bridge first above mentioned to the city of Rock Island, in the State of Illinois: *Provided, however*, That the same shall be done without any expense to the Government of the United States, and under the direction, and shall continue under the control, of the Secretary of War.

SECTION 3. That in case any railroad companies authorized by law to cross said Government bridge cannot agree upon a time-table to control the running of their respective trains thereon, the Secretary of War shall determine the question of difference, and fix the time for the trains: *Provided*, That the point where said bridge shall strike the Illinois shore shall not be more than two hundred feet from the present Government wagon bridge: *And provided also*, That said track and bridge shall be completed within two years from the passage of this act. And when completed, any other railroad company or companies shall be permitted, under the direction of the Secretary of War, to pass their trains of cars over last named bridge and track and approaches thereto, upon paying to the parties then in interest their proportionate share of the cost thereof, and of keeping the same in repair: *And provided further*, That nothing contained in this act shall be so construed as to interfere with any right or claim of the United States to control so much of the original line of bridge as is located east of the main channel of the Mississippi River.

SECTION 4. That the Davenport and St. Paul Railroad Company shall have the right to use the approaches to said bridge; and in case the parties hereto cannot agree upon the terms for using said approaches to said bridge, then, and in that case, the same shall be fixed by the Secretary of War, upon such terms and in such manner as he may deem just and proper.

An important point in regard to this bill has been omitted in the discussion of the subject, and is contained in the indorsement on the application of the Rock Island Ferry Company for relief from injury to their business done by the United States in making the Rock Island bridge a highway, and in a letter to the president of the Peoria and Rock Island Railroad Company. It is the advantage, and even necessity, to the United States, of getting all railroad companies to procure a right of way across the whole bridge, in order that the arsenal-railroad track, in connecting with the one railroad across the island, may thereby connect with all the railroads. It is impracticable for the United States to connect with the various railroads coming to the adjacent cities in any other way.

The bridge referred to in the preceding act has not been built, and the right of way referred to has not been acquired.

CORRESPONDENCE RELATING TO THE REMOVAL OF THE CHICAGO, ROCK ISLAND AND PACIFIC RAILROAD COMPANY'S OLD BRIDGES, EMBANKMENTS, AND RAILROAD-TRACK ACROSS THE RIVER AND ISLAND, AND ACTION TAKEN BY CONGRESS AND THE WAR DEPARTMENT RESPECTING THE SAME.

This subject also embraces some correspondence and action taken by Congress and the War Department in regard to leaving in the river the north pier of the bridge across the main channel as a protection for river-levees and steamboat-landings of the city of Davenport.

On the 21st of February, 1872, I wrote to the Chief of Ordnance as follows:

The order of the Secretary of War, dated July 8, 1869, transferring the charge of the construction of Rock Island bridge from the Ordnance to the Engineer Department, makes no mention of the work of removing the old railroad-track from the grounds of this arsenal. I respectfully request that I may be informed whether it remains the duty of the commanding officer of this arsenal to see that the railroad company's guarantee and the acts of Congress respecting this part of the work are complied with. If the railroad company is to remove the embankments of its old road-bed on the island, there are many and important reasons why the work should be under the charge of the commanding officer of this arsenal.

The earth for the embankments was taken principally from the grounds of the arsenal in the vicinity of the railroad-track, and a portion of it should be returned to the places from which it was taken. A portion of it is also required in the construction of the new arsenal-railroad track, the avenues, and other improvements at the west end of the island.

I should like to arrange with the railroad company terms favorable to the Ordnance Department for our mutual assistance in the performance of the work.

If I am in charge of this work, I respectfully request that I may be informed whether the United States can require the railroad company to remove the road-bed and embankments of its old track across the island. The act of Congress, dated July 20, 1868, directing the construction of the Rock Island bridge, says "that the railroad company shall remove their railroad *track* from its present location on the island of Rock Island."

The guarantee, signed by J. M. Schofield, Secretary of War, and John F. Tracy, president of the Chicago, Rock Island and Pacific Railroad Company, says "said company agrees to relocate the track across said island." I believe that railroad companies technically designate a railroad-track to be what is laid on a road-bed. It is my opinion, however, that the railroad company understands that it is to remove the road-bed, but the removal of some of the embankments will be expensive, and I would like to know the intention of the law, and whether we have the power to compel them to remove the embankments, before acting in the matter. I have to state in this connec

tion that the acts of Congress and guarantee referred to above describe the new railroad-track across the island as being a part of the Rock Island bridge, and, therefore, I understand the charge of its construction is turned over to the Engineer Department. I consider it my duty, however, to promote the interests of this arsenal as much as I can by requests to the engineer officer in charge of the work respecting the character of that part of the work that is on the island.

A copy of this letter is furnished to Colonel Macomb, the engineer officer in charge of the work. I also inclose for your information a copy of a letter written by me to Colonel Macomb.

The following letter, which is the letter inclosed to the Chief of Ordnance referred to above, anticipates many questions respecting the ownership of the bridge, right of way across it, &c., that have arisen since it was written, and gives views respecting the same held at the early date of the letter.

No answer to the letter was received, and no decision of the questions arising from the wording of the acts of Congress and guarantee has ever been obtained, and I have not been able to ascertain whether any plan for the new railroad-embankment on the island and railroad-bridge across the south channel was agreed upon between the railroad company and the United States, as required in the acts and guarantee.

ROCK ISLAND ARSENAL, ILLS.,
February 23d, 1872.

Col. J. N. MACOMB, U. S. Eng'r,
In Charge of Construction of Rock Island Bridge, &c.,
Rock Island, Ills.:

SIR: I respectfully ask for your views and for information respecting certain matters pertaining to the construction of the Rock Island bridge under your charge. The several acts of Congress authorizing and directing the construction of the Rock Island bridge, and the guarantee by the Chicago, Rock Island and Pacific Railroad Company to fulfill the conditions of those acts, describe the Rock Island bridge to be "a bridge to connect the island of Rock Island with the cities of Davenport and Rock Island," and (in some places) "the railroad on and across said island of Rock Island." This description of "the bridge" is maintained particularly in the guarantee, and whenever either portion of the bridge is mentioned, it is described "as that part of said bridge to connect," &c.

These acts of Congress, and the guarantee also, require that the Chicago, Rock Island and Pacific Railroad Company shall build that part of said bridge which is to connect the island with the city of Rock Island and the railroad across the island, but provide that the ownership of said bridge shall remain in the United States; and require, further, that the railroad company shall forever bear half the cost of maintaining said bridge.

It appears to me, after careful study, that the acts of Congress and guarantee referred to bear the construction that the ownership of that part of the bridge which is to connect the island with the city of Rock Island, and also the track across the island, is to remain in the United States, and that this part of the bridge (as well as that part over the main channel) is to be maintained by the United States, and that half the cost of such maintenance is to be borne by the United States.

I think interests important to this arsenal are involved in this question, and I respectfully ask your views respecting it; that is, is it intended that the United States shall own the whole bridge, (including the part built by the railroad company,) and maintain and keep in repair the whole bridge, the railroad company paying one-half the cost of the same? I am inclined to believe that such is the intention of the acts of Congress, because a particular reason why the Government interested itself in the building of the bridge was that a means of transit across the river might be provided for all railroads desirous of crossing the river at this point, (in such a way as to inflict the least possible injury to this arsenal,) and therefore prevent application to Congress from other railroad companies to cross or come upon the island.

If the United States does not now own and control the whole bridge, then the Government cannot provide for the passage of other railroads over the bridge.

This was, I believe, General Rodman's idea when he planned the new route and bridge, and it is a matter of much importance to this arsenal. The acts of Congress and the guarantee further provide that "the bridge shall be built upon a plan to be agreed upon by the Secretary of War and the railroad company."

If a plan for the part of the bridge to connect the island with Rock Island, and for the construction of the embankment across the island, has been agreed upon, and if

you can furnish me with a copy of the plan, I will be greatly obliged to you for it. It would be of use to me in devising plans for the new arsenal switch, avenues, fences, and other improvements at the west end of the island.

If the Government must maintain the bridge, and bear a portion of the cost of the maintenance, the plan adopted is of importance, as I suppose the care of the bridge will eventually devolve upon the Ordnance Department, and upon the commanding officer of this arsenal.

If a plan was agreed upon, I should suppose it would have been done under the administration of General Warren.

I cannot find that anything was done about it before the work was turned over to General Warren by General Rodman.

I have felt much hesitation about writing to you on this subject, and I hope you will understand that I have done so only because I feel that ordnance interests at this place are much concerned in what I have written, and I wish to do anything in my power to promote those interests.

I inclose a copy of a letter to the Chief of Ordnance.

I am, colonel, very respectfully, your obt. servt.,

D. W. FLAGLER,
Capt. of Ordnance, Comdg.

On the 21st of December, 1872, I wrote to the Chief of Ordnance as follows:

Referring to my letter to you, dated February 21, 1872, respecting the removal of the old railroad-bridges to and the old railroad-track across this arsenal, and inclosing a copy of a letter on the same subject to Colonel Macomb, the officer in charge of the construction of the new bridge, I have the honor to state that the Chicago, Rock Island and Pacific Railroad Company are now removing their old bridges, and I respectfully request a reply to so much of the letter as relates to my duties in attending to the work, and seeing that the railroad company's contract is complied with.

If it is decided that the order of the Secretary of War, dated July 8, 1869, does not leave this work in the charge of the commanding officer of this arsenal, for reasons stated in my letter, I respectfully request that, if practicable, so much of the work as relates to the removal of the embankment and abutments on the island and the piers in the water-power tail-race (that is, of the bridge to the Illinois shore) be turned over to the commanding officer of this arsenal.

I believe there are no interests involved in this part of the work except those belonging to this arsenal, and the removal of the obstructions in the water-power tail-race is very important. I cannot learn that there is at present any intention of removing the embankment extending out into the tail-race from the Illinois shore, and that embankment, in connection with the embankments of the new railroad-bridge, forms a considerable obstruction to the tail-race. I understand that it is not the intention of the railroad company to remove the embankment on the island, and I do not recommend that any effort be made to compel them to do so.

I think the interests of the arsenal will be best preserved if the Ordnance Department levels the embankment and uses it in the future improvements of the arsenal. I have not obtained any replies to my inquiries on these subjects, made to Colonel Macomb, in the letter referred to herein.

On the 3d of January, 1873, the Chief of Ordnance returned the above letter, with a copy of the order of the Secretary of War, dated July 8, 1869, and the following indorsement, and stated that by the order it would be seen that only the construction of the bridge and the approaches thereto was transferred to the Engineer Department:

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, January 3, 1873.

Respectfully returned to the commanding officer of Rock Island arsenal, with a copy of the order of the Secretary of War, dated July 8, 1869, by which it will be seen that only the construction of the bridge and the approaches thereto was transferred to the Engineer Department. The removal of old tracks, bridges, and all the other things mentioned in the railroad company's agreement, remains under control of the Ordnance Department, and you are charged with the execution and control of the same.

By order of the Chief of Ordnance.

S. V. BENÉT,
Major of Ordnance.

On the 6th of January, 1873, a copy of the foregoing indorsement was furnished to Colonel Macomb.

On the 2d of May, 1873, I addressed the following letter to Hon. Hugh Riddle, vice-president of the Chicago, Rock Island and Pacific Railroad Company:

ROCK ISLAND ARSENAL, *May* 2, 1873.

SIR: The contract between the president of your company and the Secretary of War requires that the piers of the old railroad-bridge across the river at this place shall be removed within six months after the time that the new Rock Island bridge is completed and ready for use by your company. As you are aware, this has not been done. I know some of the causes of delay in the completion of the work, but as I am required to attend to the execution of that contract, I deem it my duty to report to the Secretary of War the condition of the work and, as far as I am able, the causes of the delay in its completion.

I will be, therefore, greatly obliged to you if you will give me, in writing, a statement of the causes which have prevented the completion of the work at the time required and of anything else you may wish to say on the subject, that I may embody it in the report.

In view of the probability that complaints will be made respecting the piers by rivermen, and the possibility that an accident may happen causing investigation, and that the subject be brought to the attention of the Secretary of War in an unpleasant way, detrimental to your interests, I deem it wise and prudent that this report be made.

Very respty., your obedt. serv.,

D. W. FLAGLER,
Capt., Comdg.

To which the following reply was received:

CHICAGO, ROCK ISLAND AND PACIFIC RAILROAD,
OFFICE OF THE GENERAL SUPERINTENDENT,
Chicago, May 6, 1873.

D. W. FLAGLER,
Bvt. Lt. Col., U. S. A., Comdg. Rock Island Arsenal:

SIR: The lateness of the season when the new bridge over the Mississippi at Rock Island was opened for traffic, (October 7,) and the unusual severity of the past winter, has made it impossible to entirely remove the piers of the old bridge within the time prescribed in the contract entered into between the Rock Island Railroad Company and the Secretary of War. Immediately after the removal of trains to the new line, a large force of men were set at work taking down the superstructure. A flood in the river shortly after we commenced swept away the false work, causing a delay of two or three weeks before the work could be renewed. During the winter the taking down of piers and removal of stone on the ice was vigorously prosecuted whenever the weather would permit, and a contract was entered into with George Williams, a well-known contractor for the removal of river obstructions, to take out those portions of the piers below the surface of the water.

In the breaking up of the ice the contractor's boats and machinery were greatly damaged, and he was not able to commence his portion of the work as soon as expected.

At the present time the entire superstructure has been taken down, and the two piers east of the draw-pier have been removed, it is believed, to the required depth below water.

Two of those west of the draw have been taken down to low water, and a considerable portion of the drawn-pier removed.

The contractor promises to push the work to completion as rapidly as possible, and I respectfully request, in behalf of the railroad company, that you will represent the facts to the honorable Secretary of War with such recommendations as will secure the necessary extension of time.

Very respectfully, your obedient servant,

HUGH RIDDLE,
Vice-President.

On the 7th of May, 1873, I wrote to the Chief of Ordnance as follows:

I have the honor to transmit herewith a letter from the vice-president of the Chicago, Rock Island and Pacific Railroad Company, respecting the delay which has occurred in the removal of the piers of the old railroad-bridge across the river at this place, and to request that the matter may be laid before the Secretary of War, and his orders obtained in the case.

The guarantee given to the Secretary of War by the railroad company requires the removal of the piers within six months after the completion of the new bridge by the United States. Although the new bridge was ready for use on the 7th of October, the

old bridge was required for use in the benefit of the United States, and, at my request, for about two weeks after that time. Owing to the magnitude of the work, and the fact that appropriations for the work were not available until in July, 1872, the new Arsenal Railroad, to connect with the new Chicago, Rock Island and Pacific Railroad track across the island, could not be completed by October 7, and, as it was highly important that receipts of stone at that season should not be interfered with, the railroad company, at my request, left their old track and bridges intact, and continued to transport stone for me over their old track and my old switch for two weeks of their best season for work, after they had begun to use the new bridge and track. This delay was also important to the United States for some economical reasons. The other causes of delay in the removal of the piers of the old bridge are as stated by Mr. Riddle in his letter, and are, in my opinion, sufficient causes. The two piers at the south or island end of the bridge being now removed, all the channel part of the river is clear, and the other piers do not offer very considerable obstructions to navigation. Moreover, the unusually high stage of water this season will prevent the prosecution of the work of removing the remainder of the piers economically, probably before the middle of June. For all of these reasons, I respectfully recommend that the time for completing the work be extended till the close of this season. In view of a joint resolution of Congress, approved March 3, 1873, (marked "Resolution not of general nature, No. 3,") authorizing the Secretary of War, in his discretion, to permit the north pier (near the Iowa shore) to remain for the protection of the river-landing at Davenport, Iowa, the railroad company has, at my request, suspended work on this pier until the citizens of Davenport can collect petitions and statements of facts for the information of the Secretary of War, and until I can procure further information respecting the effect of this pier upon raft-navigation—the only navigation affected by it. These papers, with report, will be transmitted as soon as they are ready. The piers of the bridge across the channel south of the island (in our water-power tail-race) have been removed to low-water mark, and the masonry in the water, and a portion of the embankment leading to the abutment on the Illinois shore, and the abutment, should be removed during low water this season.

In this connection I would respectfully invite your attention to that part of my letter to you dated February 21, 1872, which relates to the removing or leveling down of the embankments and road-bed of the old railroad-track across the island, and to state that, unless I receive instructions to the contrary, I will in my annual estimate of this year include an estimate of funds for this work.

On the 21st of May, 1873, the Chief of Ordnance returned the foregoing communication with the indorsement that my—

Communication of May 7 had been referred to the Secretary of War, with the recommendation that the railroad company be authorized to delay the removal of the piers until November 1, 1873, and that this recommendation received the approval of the Secretary of War May 19, 1873.

And on the 28th of May, 1873, I notified Mr. Hugh Riddle, general superintendent of the Chicago, Rock Island and Pacific Railroad Company, that the time for the removal of the piers of the old bridge had been extended by the Secretary of War until November 1, 1873.

Letter from Captain Flagler to the Secretary of War, inclosing papers relative to retaining in the Mississippi River the north pier of the old railroad-bridge.

ROCK ISLAND ARSENAL, *June 23d*, 1873.

Hon. W. W. BELKNAP,
Secretary of War, Washington, D. C.:

(Through the Chief of Ordnance, U. S. A.)

SIR: I have the honor to transmit herewith the letters from Hon. H. Price and Hon A. R. Cotton, M. C., of Iowa, a petition signed by influential citizens of Davenport, Iowa, respecting the retention of the north pier of the old Chicago and Rock Island Railroad bridge across the river at this place. The retention of this pier is placed in the discretion of the Secretary of War by "Resolution not of general nature, No. 3," approved March 3d, 1873.

I supposed until the receipt of instructions from the Ordnance Office, dated January 3, 1873, that the removal of the piers of the old bridge was in the charge of the Engineer Department, and I believe some recommendation was made by that Department before the work was placed in my charge.

Almost six weeks ago the citizens of Davenport asked that the pier might be left until papers could be submitted for your consideration, and at my request work on the

pier was suspended, and the pier is still standing, except the top seven (7) feet, (about,) which had been removed.

As regards leaving the pier as it is permanently, I have to state that it affects the steamboat interest in no way. The officers of the Northern Line Packet Company inform me that they do not object to its retention.

I inclose herewith a profile of the bed of the river on the line of the old bridge, showing the pier and the position of the channel, from which it is clear that the pier cannot interfere in any way with boats, and that it does not modify materially the cross-section of the stream.

Since the date of Mr. Price's letter two rafts have struck the pier and have been injured by it. I have made considerable inquiry about the pier among raftsmen, raft-pilots, and lumbermen, and find that the pier does not interfere with rafts, except those that have no pilots nor good raftsmen who are acquainted with this part of the river. Such rafts generally keep close to the shore, and pass under the shore-space of the new bridge, and the pier in question is in their way, not much at low water, and considerably at high water. Therefore, pilots desire the retention of the pier and raftsmen and lumbermen generally desire its removal. It is in order to guard against the rafts that run close to the shore that the citizens of Davenport desire the retention of the pier. Without it such rafts, particularly log-rafts, would run against, break, and set adrift the rafts tied to the Davenport levee, and injure the lumber business of the city. This has occurred several times this season even with the pier. It appears, then, to be a question as to whether the pier does more harm to the lumber interest on the river or affords more benefit to the city of Davenport. The rafts have the whole river open to them, and can run down without any considerable increase of difficulty from the retention of the pier; while its removal nearly destroys the usefulness of the lumber-levee lying between the sites of the two bridges. I respectfully recommend that the request of the petitioners be granted.

I am, sir, very respectfully, your obt. servt.,

D. W. FLAGLER,
Capt. of Ordnance.

DAVENPORT, *May 24th*, 1873.

Col. D. W. FLAGLER,
Comdg. R. I. Arsenal:

SIR: I understand that by a joint resolution of Congress, at its last session, the question of allowing the north pier of the old railroad-bridge at this place to remain or not was left optional with the Secretary of War.

This action of Congress was the result of a petition very numerously signed by men largely engaged in the lumber business on the river, and by the officials of our city, all of whom allege that this pier is no obstruction to the free navigation of the river, and that it is needed as a protection of the levee near which it is situated.

Knowing something of the facts and of the situation, I take the liberty of giving you my views in reference to the matter, thinking possibly some suggestions of mine may aid you in arriving at correct conclusions.

It is not alleged, I believe, by any one that this old pier is an obstruction to steamboat-navigation, because the draw-pier of the Government bridge and the steamboat channel are both on the other side of the river. But it may be claimed by some that this old pier is an obstruction to the navigation of the river by rafts.

If such an objection is made, the answer is found in the fact that no raft destined for any point below this ever did run between this old pier and the shore, and during the present season, although many rafts, both of logs and lumber, have passed down the river, not one of them has touched this old pier.

The city has for some years been improving the landing opposite to and above and below this old pier for the purpose of accommodating the large lumber business of the river centering here, and when said improvements are finished, something in the nature of this old pier, it is claimed, would have to be placed here for the protection of these improvements. If the immense lumber trade at this point that is supplied by the river is not only satisfied, but anxious that this pier should remain, and if no steamboat interest is or can be affected by it, it would seem that the opinions of a few men whose interests may seem to be in favor of its removal should not be allowed to control.

From all that I know in reference to this matter, I have no hesitation in saying that the material interests of the country will be better subserved by allowing the pier to remain than by having it removed, at least until the business of the present season shall demonstrate which would produce the greatest good.

Hoping that I may be pardoned for thus obtruding my opinions upon you, I am, very truly, yours,

H. PRICE.

LYONS, IOWA, *May 31st*, 1873.

Hon. W. W. BELKNAP,
Secretary of War:

SIR: The people of Davenport feel a great interest in having the north pier of the old Rock Island bridge remain, and many there familiar with the navigation of the Mississippi are of the opinion that the pier will not prove an obstruction to the navigation of the river.

I hope you can find it consistent with the public interest to permit the pier to stand.

Very respectfully, yours,

AYLETT R. COTTON.

To the Hon. W. W. BELKNAP,
Secretary of War, Washington, D. C.:

Your petitioners, the undersigned, residents and citizens of Davenport, in the State of Iowa, would most respectfully ask that the north pier in the Mississippi River of the old railroad-bridge be permitted to remain as a protection to the city levee, for the reasons accompanying this petition.

J. H. MURPHY, *Mayor.*
H. LISCHER, *Alderman.*
GEORGE S. SHAW, "
C. C. COCK, "
J. H. SEARS, "
C. H. FICKE, "
OTTO KLUG, "
EDWARD GRACE, "
E. J. JENNINGS, "
And numerous others.

RESOLUTION NOT OF A GENERAL NATURE.—No. 3.

JOINT RESOLUTION in relation to the old bridge at Rock Island.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That for the purpose of protecting the landing at Davenport, Iowa, the Secretary of War may, in his discretion, permit the north pier of what is termed in the joint resolution of July twentieth, eighteen hundred and sixty-eight, the "old bridge" over the Mississippi River at Rock Island to remain in its present position, in case said pier does not obstruct navigation.

Approved March 3, 1873.

On the 28th of June, the Chief of Ordnance forwarded to the Secretary of War the foregoing papers and resolution, and recommended that the pier be permitted to remain in its present position.

On the 1st of July, 1873, the recommendation of the Chief of Ordnance was approved by the Secretary of War, and on the 2d of July the Chief of Ordnance returned the papers to the commanding officer, Rock Island arsenal, and directed that he inform the parties interested of the action of the Secretary of War, and that he return the papers to his office.

On the 5th of July I notified A. Kimball, assistant general superintendent Chicago, Rock Island and Pacific Railroad Company, and Hon. J. H. Murphy, mayor of Davenport, Iowa, of the decision of the Secretary of War that the north pier should not be removed, and on the same day returned the papers to the Chief of Ordnance, with the information that all parties interested had been informed of the action of the War Department.

On the 24th of September, 1873, I wrote to the Chief of Ordnance, as follows:

Referring to your indorsements on my letters, dated December 21, 1872, and May 7, 1873, in reference to the removal of the piers of the old railroad-bridge across the Mississippi River at this arsenal, I have the honor to report that the piers and the coffer-dams around them have been removed by the Chicago, Rock Island and Pacific

Railroad Company to a grade of 4 feet below low-water line of 1864, as required by the guarantee of said company. I transmit herewith a chart of soundings on the line of the old piers. The pier shown in black is the one authorized to be left standing by the Secretary of War, under date of July 1, 1873.

In my annual estimate for the year ending June 30, 1875, $22,500 was estimated for removing the old embankment and piers in the south channel, with following remarks:

The removal of this embankment is necessary, and was one of the principal objects in view in getting the railroad-track of this company removed from its position across a central part of the island. The piers and embankment in the south channel, or Sylvan Water, taken in connection with the embankments and piers of the two other bridges below, are a serious obstruction to the channel, upon which the water-power is dependent.

If it is the intention of Congress that the railroad company should remove these piers and embankments, some action by the Government is required to force the railroad company to remove them.

This matter is discussed in my letter to the Chief of Ordnance dated February 21, 1872.

In the annual estimate for the year ending June 30, 1876, $19,500 was estimated for removing the old embankment and piers in the south channel, with the same remarks appended that had been made in regard to the estimate of the preceding year, with the following additional explanation:

I had supposed until last year that the railroad company would remove the piers from Sylvan Water and the embankment from the Illinois shore. I append a copy of a letter, marked "A," from the railroad company on this subject, in which they refuse to remove the embankment, and the piers from Sylvan Water:

"CHICAGO, ROCK ISLAND AND PACIFIC RAILROAD CO.,
"SUPERINTENDENT'S OFFICE,
"*Davenport, Iowa, May* 31, 1873.

"Col. D. W. FLAGLER,
"*Commanding Rock Island Arsenal:*

"DEAR SIR: Mr. Riddle writes me that he has carefully examined the contract between the United States and the railroad company, and he finds nothing requiring the company to remove the piers from the slough.

"In one place it says 'the old bridge shall be removed from the main *channel*,' and in the contract, signed by both parties, the language is 'and the said company agrees to remove its present bridge across the main channel of said river west of the said island.'

"Mr. Riddle instructs me to take no action towards the removal of piers in slough, or the removal of embankment of the old track unless I have further instructions.

"Respectfully, yours,

"A. KIMBALL,
"*A. G. Supt.*"

On the 16th of July, 1875, the Chief of Ordnance wrote a letter referring to extract from act of Congress approved March 3, 1875, and asked whether the railroad company had removed the piers and abutments, &c., in order that the requirements of the law might be carried out.

On the 22d of July I answered the foregoing letter of inquiry, as follows:

The railroad company has already removed all the piers in the main or north channel of the river, except a portion of the "north pier" mentioned in the act referred to.

The company has also removed the piers in the south channel of the river, to a level a little below low water. The work that has not been done, and that the act of Congress referred to requires to be done, is to remove the remainder of the stone piers in the south channel to four feet below low water, so much of the embankment and abutment on the Illinois shore as extends into the river beyond a line joining the abutments of the new railroad bridge and the Rock Island wagon bridge, the embankment and abutment extending out into the south channel from the island shore, and the embankment on the island.

It is much better that the United States should remove or grade down the embankment on the island. The cost would be little, and the material in it is valuable and required for filling and grading along the line of the embankment. Its removal would be a loss, and if the railroad company level it down they would probably do the island more harm than good. I have already used about half of the embankment in grading, building roads, and in building the arsenal railroad. I respectfully ask attention to my letters dated February 21, 1872, and December 21, 1872, and to remarks in my annual estimate in regard to the work to be done by the railroad company. They were intended to apply only to the removal of embankments and piers in Sylvan Water, (south channel,) and not to the portion of the embankment left on the island.

On December 1, 1875, the following letter was received from Mr. A. Kimball, assistant general superintendent of Chicago, Rock Island and Pacific Railroad Company:

Owing to the very low water in the east (or south) channel of the river, our contractor for taking out the piers of the old bridge is unable to work his dredge, and the cold weather appears to have stopped his work on the embankment.

If the order to remove the piers and embankments contemplated that the work should be *completed* within six months from the date of the order, we must ask for an extension of time.

There has been no disposition on the part of the company (since it was decided that the work should be done by the company) to delay it. The contract was let as soon as a dredge could be had.

I indorsed the above letter as follows:

Respectfully referred to the Chief of Ordnance. The facts in this case are as stated within. It would be nearly impracticable and very expensive to do some parts of this work while frozen and during the intense cold of winter. I know of no objection to delaying the completion of the work until June 30, 1876, and respectfully recommend that, if practicable, authority for this delay be granted.

On the 14th of December, 1875, the Chief of Ordnance wrote as follows:

COMMANDING OFFICER,
Rock Island Arsenal:

SIR: The extension of time asked for by the Chicago, Rock Island and Pacific Railroad Company in removing the piers and embankments, as per their letter to you of December 1, 1875, is granted them, provided the work shall be completed before June 30, 1876.

S. V. BENÉT,
Brig. Gen'l, Chief of Ordnance.

This work has been satisfactorily completed during the past season, (1876.)

The greater part of the earth in the embankment on the island has been used by the United States in constructing roads and in grading grounds.

A small part of it remains available for this purpose.

THE SUBJECT OF HORSE-RAILWAYS ACROSS THE GOVERNMENT BRIDGES WHICH CONNECT THE ARSENAL AT ROCK ISLAND WITH THE CITIES OF DAVENPORT, IOWA, AND ROCK ISLAND, ILL., AND ACROSS SAID ARSENAL.

On the 10th of February, 1872, the Chief of Ordnance referred to me for report and recommendation the following bill:

[Senate 581. Forty-second Congress, second session.]

IN THE SENATE OF THE UNITED STATES,
February 5, 1872.

Mr. Harlan asked, and by unanimous consent obtained, leave to bring in the following bill; which was read twice, referred to the Committee on Military Affairs, and ordered to be printed.

A BILL to empower the Secretary of War to establish, under certain conditions, a horse-railway upon and over the island of Rock Island and the bridges erected by the United States, connecting the cities of Davenport and Rock Island therewith.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he is hereby, authorized and

empowered to have located and built, in such manner as he may deem fit, upon the island of Rock Island, in the State of Illinois, and upon the bridges connecting it with the cities of Davenport, Iowa, and Rock Island, Illinois, a continuous line of double-track passenger-railway, at the expense of the Davenport City Railway Company, incorporated under the laws of the State of Iowa, the Moline and Rock Island Horse-Railway Company, incorporated by act of the general assembly of the State of Illinois, and J. W. Spencer and Thomas J. Robinson, owners and proprietors of the ferry franchise between the cities of Rock Island, Illinois, and Davenport, Iowa, who shall have the privilege of operating the said railway at their own expense, under such regulations and restrictions as to the times and manner of running the cars, and keeping of the roadways and tracks in repair, and the rates of fare, as the Secretary of War shall, from time to time, prescribe; the said privilege to be at all times liable to suspension or revocation by the Secretary of War whenever in his judgment the public interests may demand it.

SEC. 2. That the said companies shall be required, whenever so directed by the Postmaster-General, to carry the mails of the United States to and from the cities of Davenport, Iowa, and Rock Island, Illinois, and shall have no claim for compensation for such service beyond that which may be ordered to be paid, as in his view equitable and just, by the Postmaster-General.

SEC. 3. That if any person or persons shall willfully and unnecessarily obstruct or impede the passage on or over said railway, or any part thereof, or shall injure or destroy the cars or any property belonging to said companies, the person or persons so offending shall forfeit and pay for every such offense the sum of twenty dollars to said companies, and shall remain liable, in addition to said penalty, for any loss or damage occasioned by his, her, or their acts as aforesaid; and that suits therefor may be had in the courts of the United States, or in any State, county, or municipal court in the county or city in which said companies are located, having jurisdiction in similar cases.

[Indorsement thereon.]

ORDNANCE OFFICE, *February* 10, 1872.

Respectfully sent to the commanding officer Rock Island arsenal for report and recommendation. He will report the width of the wagon-bridge connecting the town of Davenport with the island of Rock Island, and the width of the wagon-bridge connecting the island with the town of Rock Island. Report to be made at as early a period as practicable.

A. B. DYER,
Chief of Ordnance, U. S. Army.

ROCK ISLAND ARSENAL, ILL.,
February 15, 1872.

THE CHIEF OF ORDNANCE,
U. S. Army, Washington, D. C.:

SIR: I have the honor to return herewith a copy of a bill "to empower the Secretary of War to establish, under certain conditions, a horse-railway upon and over the island of Rock Island, and the bridges erected by the United States connecting the cities of Davenport and Rock Island therewith," referred to me by you on the 10th instant, for report and recommendation.

In my opinion the construction of a passenger railway, as contemplated in this bill, under proper restrictions and regulations, would be advantageous to the United States for the following reasons:

1st. Such a railway would greatly benefit the cities of Davenport, Rock Island, and Moline, and the growth and prosperity of those cities benefit this arsenal indirectly. If this benefit can be consistently granted to those cities, unnecessary opposition offered by this arsenal to conferring such a benefit would, in a measure, be detrimental to the interests of the arsenal.

2d. In my opinion the service of such a railway would diminish the passage of vehicles over these bridges. The distance between the business centers of the cities of Davenport and Rock Island (via the bridges) is 1½ miles. Many persons would not be willing to walk so great a distance, and, without the convenience of cars, would desire to cross in vehicles.

3d. This railway would make a continuous line of railway from Moline to Davenport and Rock Island, and would, I think, diminish the number of vehicles desiring to cross the river, in passing between Moline and Davenport particularly.

The foregoing reasons are principally dependent on the following:

* * * * * * * *

(NOTE.—A portion of this report is omitted, as it only reiterates what has already been said in several other letters, and indorsements on papers, relating to the bridge.)

4th. The citizens of Moline are endeavoring to procure the building of a Government bridge from Moline to this arsenal. The objection to this bridge (aside from expense)

is, that it would undoubtedly lead to an effort on the part of the citizens of Moline and Davenport to procure the privilege of passing over the Government bridges and the arsenal roads, throughout the whole length of the island, through the busiest part of the arsenal and among the public buildings and shops, and other public property, for their private benefit.

Such a privilege would be in the highest degree injurious to the interests of this arsenal, and should be prevented at all hazards. The proposed passenger railway would in a measure prevent the desire for this traffic across the island. I believe that ordnance interests at this arsenal are sufficiently protected by the first section of the bill, and I regard the provision contained in a part of the 20th and in the 21st and 22 lines of that section as particularly important, that is, that the Secretary of War shall at all times have the power to exclude all persons from the limits of the arsenal without the delay of a reference to Congress.

If the privilege to build this railroad is granted, then the corporation to which this privilege is granted should enter into a written agreement, based upon the provisions of the bill, and the kind of rail, width of track that shall be laid, and other matters should be carefully considered and agreed to. Owing to the limited width of roadway, all wagon traffic must necessarily be on the car-rails. The laying of iron rails for wagons on the bridge to Davenport has already been determined upon, and such rails are necessary.

If authority to build the railway is to be granted very soon, then the laying of the wagon rails should be deferred and rails devised that will answer both for cars and wagons. It is essential that the Government and not the railway company shall provide the rails, lay the track, widen the road across the island (including the causeway leading to the Rock Island wagon-bridge) in the manner agreed upon, and that the railway company shall defray the cost or a portion of the cost of the work.

It appears to me that section 3 gives to State, county, and municipal courts legal jurisdiction over so much of the Government lands and roadway as shall be occupied by the railway. The necessity to the United States of holding jurisdiction over its arsenals is well understood, and on that account the State of Illinois has already ceded to the United States jurisdiction over the island of Rock Island, and over a portion of the river contiguous to it. If the effect of section 3 is to relinquish such jurisdiction, then I think the section should be amended by striking out lines 10, 11, and 12, and by providing that nothing in the section shall be construed to prevent the Secretary of War from exercising such control over the track and cars as is granted by the first section of the bill.

The following are some of the dimensions of the Government bridges and roadways:

Bridge from island of Rock Island to Davenport: width of wagon way, 16 feet 7 inches; length of wagon-way, 1,546 feet.

Bridge from the island of Rock Island to the city of Rock Island: width of wagon-way between wheel-guards, 20 feet; width of wagon way between bridge posts, 21 feet 4 inches; length of wagon-way 600 feet; width of causeway leading to Rock Island bridge, 38 feet; length of causeway leading to Rock Island bridge, 1,000 feet; length of road between causeway and Davenport bridge, 1,200 feet.

Very respectfully, your obedient servant,

D. W. FLAGLER,
Capt. of Ordnance, Commanding.

NOTE.—General Warren's report to the Chief of Engineers states the width of wagon-way on Government bridge to Davenport to be 17 feet. This is the width between the main posts. The stay-rods encroach upon the wagon-way 2½ inches on each side, reducing the width to 16 feet 7 inches.

Both bridges have foot-walks on each side, outside the bridge-truss.

On the 14th of February, 1872, Mr. P. L. Mitchell wrote to me, inclosing the following House of Representatives' bill:

[H. R. 765. Forty-first Congress, second session.]

IN THE HOUSE OF REPRESENTATIVES,
January 10, 1870.

Read twice and referred to the Committee on Public Lands.

AN ACT to grant the right of way for a horse-railway from the city of Davenport across the Mississippi River to the city of Rock Island.

Be it enacted by the Senate and House of Representatives of the United States in Congress assembled, That the right of way be, and the same is hereby, granted to "The Davenport and Rock Island Street-Railway Company," composed of Phil. L.

Mitchell, Cyrus L. Dart, James M. Beardsley, Ignatius Huber, Calvin Truesdale, William Jackson, William H. Gest, Levi M. Haverstick, and Samuel S. Guyer, of the State of Illinois, George L. Davenport, Add. H. Sanders, William C. Wadsworth, John J. Burtis, Francis H. Griggs, Chas. G. Plummer, Henry H. Hills, Oramel H. Watson, and Simeon S. Hobson, of the State of Iowa, and James M. Faas, of the State of Pennsylvania, to construct and operate a double-track street railway for carrying passengers across the Mississippi River and the island of Rock Island, between the States of Illinois and Iowa; and that said company shall have the right to lay tracks of its road along the carriage-way of the bridge already constructed by the United States from the Illinois shore to said island, and along the carriage-way of the bridge now being constructed from said island to the Iowa shore, and along the road on the portion of the island between the bridges and connecting the same: *Provided*, That said track shall be under the supervision of the War Department and on a plan to be approved by it: *And provided further*, That said road shall be constructed and operated in such manner as not to materially interfere with the ordinary use of said bridges as carriage-ways: *And provided further*, That the Congress of the United States may resume the rights and privileges herein granted at any time after twenty years from the date of the approval of this act.

The following correspondence respecting the construction of a horse-railway by another company across the island is interesting. It contains opinions on important subjects relating to the bridge from the Hon. James T. Lane, United States district attorney for the district of Iowa, and from Judge James Grant, a prominent lawyer of Davenport:

DAVENPORT, *April 17th*, 1872.

Col. D. W. FLAGLER,
U. S. Army, Rock Island, Ill.:

DEAR SIR: We inclose to you a copy of the charter of the Davenport Central Railway Company, by which you will perceive that said company has the right to use Front and Second streets for their street-railway up to the new Government bridge. The directors of said company have, by resolution to-day passed, which you will find inclosed, directed the extension of their railway, now in operation from the fair grounds to Second street, up Second street to the Government bridge.

This bridge is also built for the operation of street-cars, and we should, in the absence of any legislation on the subject, ask you to allow us temporarily to extend a track across the island, if we did not understand from you distinctly that the Government will allow no private ownership of property on the island. We suppose that street-cars will be, on opening the bridge, a public necessity, and without seeking to obtain any advantage to ourselves, we propose to you that if the War Department will extend the bridge railway-track across the foot of the island, we will pay such compensation for its cost or use as may be deemed equitable. We conclude that the War Department has ample power to do this without further legislation as it has to build and macadamize roads and make other conveniences for the general public.

Your ob't serv't,

JAMES GRANT,
President Davenport Central Railroad.
W. C. BREWSTER,
Secretary Davenport Central Railway.

(NOTE.—The inclosed copy of charter is omitted.)

Opinion of the Hon. James T. Lane, Davenport, Iowa, relative to the right of the Davenport Central Railway to lay their street-railway track up to the bridge.

(NOTE.—The following opinion, dated August 6, 1872, was addressed to Colonel Macomb when he was in charge of the bridge, and a copy of it was obtained from Mr. Lane, subsequently, in a correspondence with that gentleman upon another case involving the jurisdiction of the United States over the bridge and its approaches:)

I have examined the papers submitted to me, including the letter of James Grant, the president of the Davenport Central Street Railway Co., touching the right of said street-railway co. to construct its track to the Government bridge, and at your request I submit the following opinion:

The ordinance of the city council of Davenport, granting the use of the streets to said street railway co., was passed and approved April 19th, 1871, and section 1 of said ordinance authorizes said street railway co. to construct their railway "on Fourth

street to a point where the Government bridge crosses the Mississippi, unless said company should elect to run their easterly track along Second street to said bridge, said easterly track diverging from the north and south track, either at Front or Second street, as the company may elect."

It is under the provisions of this section, as above quoted, the said street railway co. claims the right to lay down its track, and having elected "to run their easterly track along Second street to said bridge," the company is now constructing the same. After a careful examination of the ordinance, I am of the opinion that the company has a right to extend its track on Second street to a point opposite to the bridge, but as the north end of the wagon part of the bridge is, as I am advised, sixty or seventy feet south from the south line of Second street, the question arises whether the company has the right to extend its track over this space and connect with the track on the bridge. I have been unable to find any ordinance passed by the city conferring any authority upon the Government over the streets at this point, or any legislation either by Congress or by the State legislature either conferring such authority or divesting the city of the control of these streets. It would seem, therefore, that at present the control and authority over these streets is vested in the city council of the city of Davenport, and inasmuch as the city council has consented to the location and building of the bridge at this point, I am of the opinion that the immediate approach to the bridge is necessarily a part of the bridge, or at least a necessary incident, and the right to the use of the street to construct and use the same in connection with the bridge is also granted to the Government, and until the bridge and its approaches are fully completed and thrown open to public travel, the Government has such control over the immediate approach as to authorize it to prevent the construction or laying a street-railroad track up to the bridge and connecting with the track on the bridge.

The question, however, is not entirely free from difficulty. The city council, by its charter, has the undoubted control over the public streets. It has granted to the Government the right to locate the bridge at the foot of Le Claire street, and also to the railway co. the right to lay its track on Second street, but it has not by any ordinance defined the rights conferred upon the Government. The remedy is by such appropriate municipal and State or congressional legislation as will clearly define the rights of all parties, and prevent difficulties which may frequently arise.

The north end of the wagon part of the bridge is located, as I am advised, at the junction of Le Claire, Second, and Front streets, but I do not know its precise relation to the lines of these streets further than I have already indicated.

Very respectfully, your obedient servant,

JAMES T. LANE,
U. S. Attorney.

Col. J. N. MACOMB,
Corps of Engineers, Rock Island:

SIR: In accordance with your request, communicated through Maj. Benyaurd, I submit the following additional opinion in relation to the control of the streets in the city of Davenport and the necessary legislation to vest the control thereof in the Government so far as requisite to the use of the new bridge.

By the statutes of Iowa the *fee-simple* title to the public streets is vested in the municipal authorities, and hence the absolute control of the streets, subject to their free unrestricted public use as such, is in the city council, which has also the right, with the consent of all the property-owners on and along such streets, to vacate the same.

While, therefore, the city council cannot divest itself of the duty and the ultimate responsibility arising from the control of the streets, yet I have no doubt it has the right to grant to the U. S. Government the use of these streets at the northern end of the bridge for constructing and, if necessary, for making them approaches to the bridge, and also the supervision thereof so far as may be required in the proper use of the bridge, subject, however, to the duty of keeping said streets always free and passable to the public in their ordinary uses as public streets.

This may be done by an ordinance to be prepared and agreed upon between the Government and the city and to be adopted and passed by the city council.

If, however, the absolute and unqualified control of these parts of these streets adjacent to the bridge is necessary to be vested in the Government, then it will be necessary either to have those parts vacated by the city or to have an act of the State legislature authorizing such control. The vacation of the streets would be very difficult, and would make it necessary for the Government to purchase the title after such vacation.

I have no doubt, however, of the power of the city council to grant to the Government all the control and supervision of the portions of these streets adjacent to the bridge and required for its approaches that may be necessary for the Government authorities to exercise in the use of the bridge.

Very respectfully, your obedient servant,

JAMES T. LANE.

ROCK ISLAND ARSENAL, *April 25th*, 1872.

Messrs. JAMES GRANT and W. C. BREWSTER,
President and Secretary Davenport Central Railway Company, Davenport, Iowa:

GENTLEMEN: I have the honor to ackowledge the receipt of your letter of the 17th inst., inclosing copy of the charter of the Davenport Central Railway Company, and requesting permission to extend a horse railway line across the Government bridges and across the arsenal lands from Davenport, Iowa, to Rock Island, Illinois.

In reply, I have to state that I have no doubt in my own mind that no power has authority to grant such a privilege except Congress, and that I certainly could not grant such a privilege.

If it were established that a *horse railway* is a *railroad*, such as is contemplated in the several acts of Congress authorizing the construction of the Rock Island bridge, then it is possible that these laws empower the Secretary of War to grant you a right of way over so much of the Rock Island bridge as you may desire to use, but a right of way gained under those laws would, in my opinion, compel a compliance with those portions of those laws which would require you to share equally with the Chicago, Rock Island and Pacific Railroad Company the expense which that company has already incurred in getting a right of way over the Rock Island bridge; and then a right of way across the arsenal and over the Government wagon bridge to Rock Island must be obtained from Congress.

The above is simply my own opinion, but I believe it is a correct one. I will state in this connection that I desire the construction and operation of a horse railway across the arsenal and Government bridges between Davenport and Rock Island, because, and only because, of the great benefit that I conceive such a railway would confer upon the towns of Davenport, Rock Island, and Moline, and because it would relieve this arsenal in a great measure from applications to pass vehicles over the bridges to the injury of Government interests.

I should, therefore, favor the construction and operation of a railway by such a company or companies as would best subserve the interests I have described, and I think it would be best that the railway should be operated by the railway companies on both sides of the river.

I have already indorsed favorably a bill which was referred to me from the United States Senate, about two months ago, to grant this right of way to the Davenport City Railway Company, Moline and Rock Island Horse Railway Company, and the owners of the Rock Island and Davenport Ferry franchise.

Very respectfully, your obt. svt.,

D. W. FLAGLER,
Brt. Lt. Col. U. S. A., Capt. of Ordnance, Comdg.

To which the following reply was received:

DAVENPORT, IOWA, *April* 27, 1872.

Col. D. W. FLAGLER,
Comdg. Rock Island Arsenal, Rock Island, Ill.:

DEAR SIR: We are in the receipt of yours of the 25th inst. Supposing that you would refer our letter to the Secretary of War, we addressed a letter to him containing suggestions as to the control of the island by the War Department, which we think would satisfy some of the difficulties suggested by you. We entirely concur and acquiesce in the propriety of the views expressed by you in conversation, that all the property of every description, including highways, bridges, and railways, whether steam or horse railways, should be under the control of the War Department, and regulated; and after our interview with you we determined not to embarrass your Department or Congress with applications for special privileges or rights to our corporation. We had no idea or belief that under the acts of Congress granting rights to the Chicago, Rock Island and Pacific Railroad for crossing their trains on the upper end of the Government bridge, that that corporation has any interest or control over the part of the bridge reserved by the Government for its own or other public use, and we have no doubt that the entire use of the lower chord of the bridge is free to the use of the United States for any purpose.

What we desired to ask of the War Department was simply this: No provision has been made by act of Congress for the use in any manner of the Government portion of the bridge; the War Department is authorized to construct a wagon road and bridge across the island, and to make compensation to the owners of the old railway bridge, (act of 1866.)

The act of 1864 authorizes the War Department to acquire the whole island for an arsenal and make it a military reservation.

Congress has made no provision for street cars run by horses, or any other vehicles, on the wagon road and bridge. It is in that respect like all other military reservations, under the control of the War Department.

In this position of affairs our corporation has the right and proposes to run its street cars to the bridge as soon as finished. We simply ask that until a final determination is arrived at by the War Department, we have the power to run our cars across the bridge and island. In our letter to the Secretary of War, which we wrote to accompany any reference you might make, we suggested that if the power to spend money by the Department for this purpose was doubted, we would advance it and take our risk of contributions from other street railways or the United States. We send you a copy of that communication, and solicit your attention and that of the War Department to it.

Your obt. svts.,

JAMES GRANT.
W. C. BREWSTER.

The following is the letter referred to in the foregoing communication:

DAVENPORT, *April 18th*, 1872.

Hon. W. W. BELKNAP,
Secretary of War, Washington, D C.:

DEAR SIR: The Davenport Central Street Railway Company has a charter from the city to build their road to the Government bridge at this place, and will be running their cars, already in operation, to the bridge as soon as it is open for travel. The bridge is constructed with a track for street cars, and the opinion was common that Congress would authorize some company to build a street railway across the foot of the island, a distance of perhaps half a mile. With this view, I was instructed by the Davenport Central Company to apply to Congress for such rights.

An interview with Colonel Flagler, the commandant, has satisfied us that our application to Congress should not have been made; that the War Department does not intend that there shall be any private ownership of property on the island, and the entire regulation of highways on the island will be under the control of the War Department. As a street-railway track has been prepared on the bridge, we infer that it will be extended across the island to the Illinois side, and that it will be open to all street railways that shall contribute such sums as the Department may require, and get authority from the local governments to run to the bridge. With this we are content. We suppose the War Department, without further legislation, has ample power to make and regulate the use of highways across the island and bridges. If you have any doubt about such power, we suggest that you obtain it. Nothing will be done in relation to private interest by the present Congress. The bridge will be open to public use in May, and unless a tramway is constructed for street cars, passengers (from town to town) will be much incommoded. The company I represent is ready to act now, to submit to all rules which you may establish for street cars crossing the bridge and island, and if the small sum necessary to extend the track across the foot of the island is of any importance, to furnish it, and look to Congress or contribution from other companies to re-imburse them. What we wish is to make money for ourselves, and accommodate the large travel which will seek the bridge during the present season.

Your obedient servant,

JAMES GRANT,
President Davenport Central Railway.

On the 30th of April, 1872, I referred the foregoing letter to the Chief of Ordnance, with the following indorsement, viz:

As the letter from Messrs. Grant and others, referred to herein, was sent to the Secretary of War direct, and is probably now at the War Office, it is respectfully suggested, if the Chief of Ordnance deem it desirable, that these papers be referred to the Secretary of War also.

Copies of the letters from Messrs. Grant and others to me and of my reply thereto are inclosed. My views respecting a horse-railroad across the Government bridges and the west end of the arsenal are fully explained in my letter to Messrs. Grant and others, (copy inclosed,) and also in a report on Senate bill No. 581, referred to me from the Ordnance Office February 10, 1872, and returned with letter dated February 15, 1872. I would respectfully invite attention to those views before any favorable action is taken upon the application of Messrs. Grant and others.

I still believe that my opinion expressed to the writers of this letter, that authority to build and operate a horse-railway across the bridges and arsenal could only be granted by Congress, was a correct one.

The act approved June 27, 1866, says, "and establishing thereon a *wagon road* for the use of the Government of the United States."

The writers ask for the building of something not a wagon road, and for the use of the same by a corporation, not the Government of the United States, for which the act does not give authority.

A number of corporations (not less than six, I believe) are applying for this privilege, and it is possible that these applicants are endeavoring to head off the others before they can obtain the authority from Congress. If the horse-railway is ever built, I think it should be operated for the following purposes:

First. To afford the greatest amount of benefit to the Government of the United States; and,

Second. The greatest amount of benefit to the cities of Moline, Rock Island, and Davenport, and to that end that it should be operated in connection with the other horse-railways on both sides of the river.

D. W. FLAGLER,
Capt. of Ordnance, Brt. Lt. Col. U. S. A., Comdg.

The Committee on Railways and Canals, appointed by the Forty-third Congress on December 17, 1873, referred House bill No. 391 to the Secretary of War for his judgment in regard to the propriety of its being passed, and having been sent by him to the Chief of Ordnance, United States Army, it was referred to me for report. The bill reads as follows:

[H. R. 391. Forty-third Congress, first session.]

IN THE HOUSE OF REPRESENTATIVES,
December 8, 1873.

Read twice, referred to the Committee on Railways and Canals, and ordered to be printed.

Mr. Cotton, on leave, introduced the following bill:

A BILL to empower the Secretary of War to establish, under certain conditions, a horse railway upon and over the island of Rock Island and bridges erected by the United States, connecting the cities of Davenport and Rock Island therewith.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he is hereby, authorized and empowered to have located and built, in such manner as he may deem fit, upon the island of Rock Island, in the State of Illinois, and upon the bridges connecting it with the cities of Davenport, Iowa, and Rock Island, Illinois, a continuous line of double-track passenger-railway, at the expense of such horse-railway companies as may desire to operate the same, which companies shall have the privilege of operating the said railway at their own expense, and only by animal power, under such regulations and restrictions as to the times and manner of running the cars, the keeping of the roadways and tracks in repair, and the rates of fare, as the Secretary of War shall, from time to time, prescribe; the Secretary of War, under the same regulations and restrictions, may permit any other horse-railway company or companies also to operate said railway upon their paying to the parties in interest their proportionate share of the cost thereof, and he shall determine the amount to be paid. The said privilege shall be at all times liable to suspension or revocation by the Secretary of War whenever, in his judgment, the public interest may demand.

SEC. 2. That the said companies shall be required, whenever so directed by the Postmaster-General, to carry the mails of the United States to and from the cities of Davenport, Iowa, and Rock Island, Illinois, and shall have no claim for compensation for such service beyond that which may be ordered to be paid, as in his view equitable and just, by the Postmaster-General.

SEC. 3. That if any person or persons shall willfully and unnecessarily obstruct or impede the passage on or over said railway, or any part thereof, or shall injure or destroy the cars, or any property belonging to said companies, the person or persons so offending shall forfeit and pay for every such offense the sum of twenty dollars to said companies, and shall remain liable, in addition to said penalty, for any loss or damage occasioned by his, her, or their acts as aforesaid, and that suits therefor may be had in any court having jurisdiction in similar cases.

SEC. 4. This act may be amended or repealed.

The foregoing papers were returned to the Chief of Ordnance, with the following indorsement:

ROCK ISLAND ARSENAL,
Dec. 23d, 1873.

Respectfully returned to the Chief of Ordnance, U. S. A.

I inclose herewith a map showing the proposed location of this railroad. The route is over the two arsenal wagon-road bridges and across the arsenal grounds, along Fort Armstrong avenue. In my opinion it would be unwise for the United States to author-

ize the building of this railroad. The control of the road would have to remain under the Secretary of War, and would present some difficulties. The track and cars on the same would furnish some obstruction to the large traffic of teams now on the bridges. This, in connection with the draw on the long bridge, the steep approach at the north end, which will probably be further obstructed by the track of the Davenport and St. Paul Railroad, and the tracks and sidings of three railroad companies, which the proposed track would have to cross at the south approach, (on the Rock Island side,) increases the likelihood of trouble and obstructions. These objections are not such as would generally prevent municipal authorities from granting a charter in like cases, but these taken in connection, the objection to and difficulties inseparable from granting private companies vested rights within a military post, and particularly an arsenal, and troubles growing out of questions of jurisdiction, are such as to make me think it would be unwise to grant it.

I do not think the citizens of the two cities are generally in favor of the building of such a track; that is, there is a feeling that the obstruction to teams would not be compensated for by the benefit to travel.

I am aware that this opinion and report does not agree with one made by me upon a similar bill last winter, but it is the result of observation during a year of use of the bridges by the public, and of a free discussion of the merits of the case.

If the railway is to be built, the provisions of the inclosed bill, leaving the whole matter in the hands of the Secretary of War, are proper, and these provisions should be insisted upon, and should not be changed.

I recommend that the 9th and 10th lines of sec. 3 be changed to read, "suit therefor may be had in courts of the United States."

It is necessary that the jurisdiction of the United States over the bridges should be maintained. The jurisdiction of the United States over the "Rock Island bridge" has already been questioned, and a case involving this question is now before the United States courts.

D. W. FLAGLER,
Capt'n of Ordnance, Bvt. Lieut. Col. U. S. A., Commanding.

TELEGRAPH LINES ACROSS THE BRIDGES AND ISLAND.

During the years 1873 and 1874 there was a good deal of correspondence with the officers of different telegraph companies respecting the erection of telegraph-lines on and across the bridges and the island. This resulted in granting, by consent of the Secretary of War, the privileges requested.

In 1873 the Western Union Telegraph Company erected a handsome iron tower on the center of the draw of the bridge, of such height as to cause the wires, rising to its summit from the top of the bridge on each side, to be above the tops of the highest smoke-stacks of steamers at high water. The tower is provided with a revolving top to permit the turning of the draw without interfering with the wires. The same company fastened insulating wooden strips to the top bracing of the bridge, from Davenport to the island, for carrying the wires, and put up along Fort Armstrong avenue and along the east side of the other bridge a line of heavy "city" telegraph-poles.

This privilege was granted to the Western Union Telegraph Company on condition that they should permit other companies to put their wires on the same line of poles and other supports upon their paying to that company a fair share of the cost. The Atlantic and Great Western Company has complied with this condition and put up its wires on the same line.

In 1872 the Western Union Company furnished me with wires, poles, and instruments and battery, and I put up a telegraph-line from the arsenal office to the west end of the island, about 1¼ miles, and connected there with the wires of the Western Union Company.

The following papers give a history of the cases involving the jurisdiction of the United States over the part of the bridge lying between the center of the main channel of the river and the city of Davenport and the Davenport approach:

UNITED STATES *vs.* WILLIAM BOEHME.

Before S. E. Brown, esquire, United States commissioner.

JUNE 13, 1873.

The defendant was arrested on the charge of the crime of an assaault with intent to kill Oscar Ohlson, a guard on the Government bridge at the Rock Island arsenal, on the night of the 11th of June, 1873.

STATEMENT OF FACTS.

Oscar Ohlson was a regular guard stationed on the main bridge between the island of Rock Island and the Iowa shore of the Mississippi River. On the night of the 11th of June, 1873, the defendant drove across said bridge several times, stopping his wagon on the bridge, and otherwise misconducting, in violation of the regulations for persons permitted to use said bridge, and on being reminded by the said guard of the regulations, and being ordered to move on, became excited, and made threats against the guard.

He came back the last time evidently with no other purpose than to create a quarrel with said guard, and conducted himself in a violent and boisterous manner, and on reaching the north end of the bridge (on the Iowa shore) demanded that the guard should come out and talk with him, which demand the guard declined to obey. Soon after the defendant drove back on to the bridge where the guard was, and stopped and began an altercation with him, and, on being ordered to move on in the track, as required by the regulations, refused, and made the assault on the guard with a loaded pistol.

He was arrested at the end of the bridge on the island of Rock Island, locked up in the guard-house, and on the next day was delivered to the United States marshal for the district of Iowa, who had a warrant for said defendant, issued by said commissioner, and was brought to trial on the charge above stated, before said United States commissioner, on the 13th day of June, 1873, at the city of Davenport, said district of Iowa.

James T. Lane, U. S. district attorney for the district of Iowa, appeared for plaintiff.

Messrs. Sweeney and Jackson appeared as counsel for defendant.

On the trial, on these facts, it was claimed by the district attorney, on behalf of the Government, that the State of Illinois, by an act of the legislature, had ceded to the United States full jurisdiction over the island of Rock Island and the waters and approaches adjacent thereto. That by various acts of Congress the United States had established an arsenal and armory on said island, and assumed complete authority and jurisdiction over the said island and the waters adjacent thereto, and constructed the bridge in question for the use of and as an approach to said island, and as a part of said arsenal and armory, and the United States had full authority and jurisdiction over the same.

That notwithstanding the offense charged was committed on that part of the said bridge which is within the county of Scott and State of Iowa, and that said State of Iowa has never by any act of its legislature ceded its authority and jurisdiction over said part of said bridge to the United States, yet the United States reserved, in the admission into the Union of both the States of Illinois and Iowa, its general authority over the Mississippi River, and, inasmuch as both the constitutions of the States of Illinois and Iowa, as well as the laws of each of said States, provided that for offenses committed on said river the jurisdiction to punish was in either State, the jurisdiction of the Federal courts in the district of Iowa was well taken in this case, if the offense was punishable by any act of Congress.

And the counsel for the United States relied upon the 2nd section of the act of Congress of the 5th of April, 1866, (see 2nd Brightly's Digest, page 166, sec. 71,) which provides as follows, viz:

"If any offense shall be committed in any place which has been or shall hereafter be ceded to and under the jurisdiction of the United States, which offense is not prohibited or the punishment thereof is not specially provided for by any law of the United States, such offense shall, upon conviction in any court of the United States having cognizance thereof, be liable to and receive the same punishment as the law of the State in which such place is or may be situated, now in force, may provide for the like offense when committed within the jurisdiction of such State; and no subsequent repeal of any such State law shall affect any prosecution for such offense in any of the courts of the United States."

The counsel for defendant claimed that inasmuch as the *locus* of the offense was

within the boundary-lines of the State of Iowa, which had never ceded its jurisdiction over said place to the United States, the offense, if committed, was exclusively cognizable in the courts of the State of Iowa.

It was conceded that by the laws both of the State of Illinois and of the State of Iowa, the offense was a felony and punishable criminally by fine and imprisonment.

DECISION.

The Commissioner held that the offense was clearly within the 2nd section of the act of Congress relied upon, and that the said Government bridge was a necessary part of the Rock Island arsenal and armory, and as such the United States had full and complete authority over it, and jurisdiction to punish offenses committed on said bridge or any part of it, and held the defendant to bail to answer an indictment in the U. S. circuit court for the district of Iowa.

Notes to the above case.

1st. The shore abutment of said Government bridge is located on the bank of the Mississippi River, within the city of Davenport and the State of Iowa, but there is no resolution or ordinance of the city council of said city authorizing or consenting to it, or giving to the United States any authority or control over the approach to the bridge, which extends over two or three of the public streets in said city.

2nd. There is an entire absence of any legislative action by the State of Iowa, giving any control or authority to the United States over that end of the bridge within the limits of the State of Iowa, or in any manner ceding to the United States the jurisdiction of said State over said territory.

3d. Congress has not passed any act providing for the management and control of that part of said bridge devoted to the use of teams and wagons, and regulating the manner of such use by teams, foot-passengers, and street-railways, and enforcing the same by the imposition of suitable penalties for violation of any of such provisions.

This case was never brought to trial, and no decision in the United States court of the question of jurisdiction was obtained.

The following correspondence relates to the Davenport and Saint Paul Railroad Company crossing the approach to the Rock Island bridge:

ROCK ISLAND ARSENAL, *Sept.* 23, 1876.

Mr. JOHN E. HENRY,
President of the Davenport and Northwestern R. R. Co., Davenport, Iowa:

SIR: In our last conversation upon the subject, I understood you to say that your company had abandoned a plan which was proposed, or talked of, that is, of running a track of your company over the approach of the arsenal bridge at the Davenport end.

The work of grading for your track, which is now going on, seems to indicate a change of plan and an intention to run the track over the approach.

Will you be kind enough to inform me whether this is true; that is, whether you still desire or propose to run your track over the approach of the bridge; and, if so, whether any steps have been taken to secure a right of way over the approach.

I should also be obliged to you for any other information on the subject that you may have to communicate.

Very respectfully, your obt. servant,

D. W. FLAGLER,
Bvt. Lt. Col. U. S. A., Comdg.

DAVENPORT AND ST. PAUL RAILROAD, RECEIVER'S OFFICE,
Davenport, Iowa, Sept. 23, 1876.

Col. D. W. FLAGLER,
Rock Island Arsenal:

DEAR SIR: Yours of this date is received and contents noted.

The city council of this city have authorized me to lay a track across the bridge-approach you mention, and I am making preparations to do so with as little delay as possible.

Yours, respectfully,

JOHN E. HENRY, *Receiver.*

ROCK ISLAND ARSENAL, *Sept.* 25, 1876.

Hon. JAMES T. LANE,
United States District Attorney for the district of Iowa, Davenport:

SIR: I am informed by the receiver of the Davenport and St. Paul Railroad Co. that his company has procured authority from the city council of the city of Davenport to construct a railroad over or through the Government approach to the arsenal-bridge at the Davenport end.

Unfortunately, I cannot find that the city of Davenport or the State of Iowa has ever ceded to the United States the land covered by the approach; but, even without such cession, it seems clear to me that, inasmuch as the city of Davenport has given to the United States the authority to use this land, and to construct thereon for its use an approach to its (the Government's) bridge, it has not now the authority to grant to another company the privilege of building over or through this approach any construction which will impair or injure the property of the United States.

In my opinion the proposed construction will seriously injure the bridge-approach, and interfere with the use of the bridge, by endangering the lives and property of those who use the bridge.

As the bridge is under my command, and property in my charge, I am compelled to protect it from injury. I have the honor, therefore, to make respectful application to you to procure an injunction against said Davenport and Saint Paul R. R. Co. from prosecuting said construction over or through the Davenport approach to the arsenal-bridge (officially known as the Rock Island bridge) until the matter can be laid before the Secretary of War, and his authority for the construction obtained.

Also, if authority to construct the railroad-track over the approach to the bridge is obtained, the plans for the construction should first be submitted to the Secretary of War and acted upon by him, in order that the track may be so constructed as to injure the property of the United States as little as possible.

As this is an urgent case, I have to request you to act in the matter as soon as possible.

As the case is so urgent, I have not time to make application to the Attorney-General to instruct you to act in the matter, and, therefore, apply directly to you, as required by law.

Very respectfully, your obedient servant,

D. W. FLAGLER,
Brt. Lieut. Colonel U. S. A., Major of Ordnance, Commanding.

To which the following answer was received:

DAVENPORT, *October* 6, 1876.

Col. D. W. FLAGLER,
Rock Island Arsenal:

SIR: I have prepared the bill for an injunction against the Davenport and Northwestern Railroad Company, and wish to see you in reference to it, and would be glad if you could call at the office to-morrow (Saturday) morning. It may be necessary to have some affidavits to use on the hearing.

Have you a copy of the report of General Warren to the city council asking for the use of the street?

If you have, I shall thank you to bring it with you.

I shall probably go to Des Moines on Saturday evening.

Very respectfully,

JAMES T. LANE,
U. S. Attorney.

ROCK ISLAND ARSENAL, *October* 6, 1876.

Hon. JAMES T. LANE,
U. S. District Attorney, Davenport:

SIR: In reply to your letter of this date, I regret to state that I have not on the files of the arsenal a copy of the report you ask for.

The Secretary of War and General Sherman are here to-day, and this will prevent me from coming to see you.

I will come over on Monday.

Very respectfully, your obedient servant,

D. W. FLAGLER,
Brt. Lt. Colonel U. S. A., Commanding.

DES MOINES, IOWA, *October* 9, 1876.

Colonel D. W. FLAGLER,
Rock Island Arsenal:

DEAR SIR: I prepared a bill for injunction, and wrote you a note to call at my office on Saturday; but I suppose you were detained by the visit of the honorable Secretary of War.

If you still desire that I make the application, you can call at our office, and Mr. Davison will read you the bill, to which you can be sworn before a United States commissioner, and can make out affidavits of yourself and any others, showing, as matters of fact, how and in what manner the construction and operation of the railroad across the approach will injure the bridge or interfere with its use by the Government.

I confess, after some considerable examination and reflection, that I have grave doubts as to the success of our application.

I have no doubt as to its injurious effect upon the use of the bridge, but do not think it is such an injury as can be remedied by writ of injunction. However, if you still desire it, and will complete the papers as above suggested, and have them forwarded to me here, I will make the application.

Very respectfully,

JAMES T. LANE,
U. S. Attorney, Dist. of Iowa.

ROCK ISLAND ARSENAL,
October 11th, 1876.

HON. JAMES T. LANE,
United States Attorney, District of Iowa, Des Moines:

SIR: I have just received your letter of October 9th. I am very anxious to make an attempt to procure the injunction, even though we fail.

I am confined to my bed, suffering much pain, and not able to attend to business.

I will try to have all the affidavits you ask for completed to-morrow.

Very respectfully, your obedient servant,

D. W. FLAGLER,
Bvt. Lt. Colonel U. S. A., Major of Ordnance, Commanding.

ROCK ISLAND ARSENAL,
October 12th, 1876.

HON. JAMES T. LANE,
United States Attorney, District of Iowa, Des Moines:

SIR: Referring to my letter of yesterday respecting the completion of certain affidavits, I find that the United States commissioner at Rock Island is absent from home and will not return for two weeks, and Mr. Davison informs me that the United States commissioners at Davenport have no authority outside the limits of Iowa.

I am still unable to leave my room, and as I am very anxious to procure the injunction restraining the Davenport and Northwestern Railroad Company from pushing their track across the approach to the Government bridge, I wish to ask if there is not some other course of procedure that will be as effective as the affidavit made before the United States commissioner?

Very respectfully, your obedient servant,

D. W. FLAGLER,
Bvt. Lt. Col. U. S. A., Major of Ordnance, Commanding.

ROCK ISLAND ARSENAL,
October 26th, 1876.

To the CHIEF OF ORDNANCE,
U. S. Army, Washington, D. C.:

SIR: I have the honor to inform you that the Davenport and St. Paul Railroad Company (now known as the Davenport and Northwestern Railroad Company) is grading for and preparing to lay its track across the approach of the arsenal bridge, known as the "Rock Island bridge," at its Davenport end.

Their authority for so doing is the marked paragraph of a copy of a Davenport city ordinance, inclosed herewith.

The amount of the control that the Government has over this approach is questionable, and is certainly limited.

The ground occupied by the United States for its approach was never purchased by the United States; was not ceded to the United States by the State of Iowa or the city of Davenport; nor can I find any ordinance of the city granting to the United States the privilege of landing its bridge and constructing its approach where it is.

The city government did, however, permit the United States to land its bridge and construct its approach, and it can be established, I think, that permission was given verbally in conferences between a committee of the city council and the commanding officer of this arsenal, while he was in charge of the construction of the bridge, to land the bridge and build the approach at some point not definitely fixed.

Afterward, however, when the point of landing was fixed, as stated above, no title to the land, no ordinance granting the privilege to use it, was obtained.

It is probable, however, that the Government having been permitted to land its bridge and build its approach, and to hold and control it for a term of years, that it has acquired the right to protect the approach from such damage or use as would seriously impair or injure the bridge.

It appears that the city council acknowledges this right, for the wording of the marked paragraph in the ordinance, inclosed herewith, was originally as follows: "Provided, however, if the War Department of the United States permit that said

line may be extended from said point opposite the east end of Third street," &c., &c. (See copy of the same ordinance, as published in a Davenport paper, transmitted herewith.)

It is probable that the change in the wording of this paragraph was procured by the officers of the Davenport and Saint Paul Railroad Company, as the ordinance as now in force admits indirectly that the United States may have authority to prevent the laying of the track.

That the city government of Davenport permitted the United States to land the bridge where it is, and to build the approach thereto, and occupy and hold it, is abundantly shown in reference to it, and action taken in regard to it at various times, as follows:

1st. Resolution to raise the grades of Le Claire, Front, and Second streets, passed by the city council of Davenport, August 18th, 1869. (This action was taken at the request of General Warren, then in charge of the bridge construction, and his request was embodied in a report, which was read in the council. I have not yet obtained a copy of this report from General Warren, but hope to do so.)

2d. Ordinance passed November 3d, 1869, granting right of way to the Davenport City Railway Company.

3d. Ordinance May 11th, 1870, granting right of way and privileges to the Davenport and Saint Paul Railroad Company.

4th. Ordinance passed February 15th, 1871, enabling the Chicago, Rock Island and Pacific Railroad Company to connect with the Government bridge.

5th. Ordinance passed December 6th, 1871, granting right of way and privileges to the Davenport and Saint Paul Railroad Company. (Supplementary to ordinance of May 11th, 1870.)

That you may understand the effect of laying a railroad-track across the approach, I have prepared, and transmit herewith, a map of the approach and adjacent city streets, and an elevation of the approach, showing also the position of the upper and lower decks of the bridge.

The line of the Davenport and Saint Paul Railroad Company, (now Davenport and Northwestern,) as now being built across the approach, is shown by the blue line. The other line, for which a right of way is granted in the city ordinance, is shown by the dotted blue line.

The ground occupied by the bridge approach is included within the red lines.

As shown by grade figures, this approach is raised above the adjacent streets, and there is a sharp grade from the streets up to the approach, and up the approach to the bridge.

The railroad-track is to cross the approach at grade.

The railroad-track will reach this level by an *easy* grade of about fifty feet to the mile, and will therefore be on an embankment on each side of the approach.

The effect of the embankment is shown in the profiles inclosed herewith.

The injuries to the approach which I apprehend from the laying of this track are as follows:

1st. Vehicles passing to and from the bridge must cross the railroad-track obliquely.

2d. The railroad embankment will be a serious obstruction to vehicles going from the bridge to Front street on either side of the approach, and a slight obstruction to vehicles going from the bridge to either Le Claire or Second street.

3d. The passage of trains across the approach must be dangerous to persons using the bridge. This danger is greatly enhanced by the following: Vehicles on the bridge are on iron rails and must keep in line, and there is no room for "turning out." The bridge is often crowded. If a line of vehicles on the bridge is approaching the end of the bridge and any animal in the line is frightened, he would probably back and the carriage be run into by the next behind, and so on. If any vehicle is broken, none of those behind it can get off the bridge till the broken one is removed. The danger of an accident in this way is increased by the partial concealment of trains by the iron-work of the bridge until the engine appears in front of the animals just approaching the end of the bridge, and by the liability of horses to take fright at the startling sound made by the exhaust-steam of an engine in pulling up the grade to the approach.

If the track were laid along the dotted blue line, the first objection would not be lessened; the second would be entirely removed, and the third nearly removed, because the train could never be seen in a place to frighten horses until they were off the bridge.

I think it specially important that action should be taken in this matter to ascertain the rights of the United States in the bridge approach.

If it is ascertained that the rights of the United States in this approach are not sufficient to enable the Government to protect its property (the bridge and approach) from injury, action should be taken to procure by legislation the needed rights, for the property is very valuable.

It does not appear that the United States has any more rights in and control of the ground occupied by the abutments (the main abutment and the abutment of the

shore-span over the approach) than it has in the approach itself. If the city can without the consent of the United States grant a right of way across the approach to a railroad-company, I do not see that the United States would have power to protect its bridge and abutments.

Unless action is taken in this case, it is to be feared that other constructions on the approach may follow, and injure still more the property of the United States.

I did not find out until the 23d of September last that the railroad company proposed to cross the approach. As there appeared to be insufficient time to write to Washington for instructions in the matter, I applied at once to the United States district attorney for the district of Iowa (Hon. James T. Lane) to procure an injunction in the United States court against the laying of the railroad-track across the approach until the matter could be examined into and the rights of the United States in the matter ascertained.

This application for an injunction has been made in the United States court, district of Iowa, and the matter has not yet been decided.

Appended hereto is a copy of some correspondence with Col. J. N. Macomb, U. S. Engineers, on this subject.

This report is respectfully submitted, as it is supposed you may desire to take some action or give me instructions in the matter, and also in case it is necessary that the matter should be submitted to the Attorney-General of the United States for his action.

Very respectfully, your obedient servant,

D. W. FLAGLER,
Major of Ordnance, Bvt. Lt. Col. U. S. A., Comdg.

Proceedings of city council of Davenport.

REGULAR MEETING, *August* 18, 1869.

Alderman Bryant read a report of General Warren in regard to the new bridge, and moved that the request of the same, namely, to raise the grade at the intersection of Le Claire and Front and Second streets about six feet, be granted.

The ayes and nays being called for, the motion was adopted by a unanimous vote.

Alderman Bryant also moved that the ordinance committee be instructed to perfect an ordinance with the foregoing resolution, to report at some future meeting. Adopted by the same vote.

Alderman Runge brought in the following resolution :

Resolved, That his honor the mayor be, and is hereby, requested to notify Major-General Warren of the action of the city council in regard to the bridge matter.

Which was also unanimously adopted.

REGULAR MEETING, *November* 3, 1869.

AN ORDINANCE to authorize the Davenport City Railway Company to extend their track and operate their horse-railway upon part of Le Claire street.

Be it enacted by the city council of the city of Davenport:

SECTION 1. That the Davenport City Railway Company be, and they are hereby, granted the right to extend their track and operate their horse-railway upon part of Le Claire street of said city, under the same rights, privileges, and conditions and restrictions as are contained in an ordinance to authorize the Davenport City Railway Company to construct and operate a horse-railway upon Third street, passed and approved December 4, 1867: *Provided*, That nothing in this ordinance contained shall be so construed as to prevent other railway companies from laying and operating a track upon the said Le Claire street: *And provided further*, That if at any time hereafter any company operating a horse-railway within the city of Davenport should desire to connect with any track which may be laid on the bridge to be erected by the United States over the Mississippi River, it or they may, upon the payment of a proportionate part of the cost of such portion to be used by it or them, connect with the track of the Davenport City Railway at any point from Third street to the western terminus of such bridge.

SEC. 2. Said railway shall commence at the intersection of said Le Claire street, and run thence south along said Le Claire street to the Mississippi River at the western terminus of the Government bridge.

SEC. 3. The rail to be used in the construction of said track shall be that known as the "tram-rail."

SEC. 4. That said railroad-track shall be laid down under the supervision of the street committee, and not otherwise.

Passed and approved Nov. 3d, 1869.

JAMES RENWICK, *Mayor.*

ADJOURNED MEETING, *May* 11, 1870.

AN ORDINANCE granting the right of way and certain privileges and rights to the Davenport and Saint Paul Railroad Company.

Whereas the city of Davenport is the terminus of the railroad proposed to be constructed by a corporation in said State known as the Davenport and Saint Paul Railroad Company; and

Whereas it is deemed expedient by the corporate authorities of the city of Davenport to afford the said railroad company proper and adequate right of way and depot privileges: Therefore,

Be it enacted by the city council of the city of Davenport:

SECTION 1. Article 1. The right is hereby granted by the city of Davenport to the said Davenport and St. Paul Railroad Company to lay down on the river-bank, in the city of Davenport, from Mound street in East Davenport, to Rock Island street, and thence on Front street to the western line of the city, a single track of its said road, with the necessary switches and side-track to such warehouses, mills, and manufactories as the said railroad company desire to reach, when the owners have previously obtained the consent of the council to the use of such facilities; and also the right to construct side-tracks to the steamboat-landing between Main and Perry streets; and there is also hereby granted to the said Davenport and St. Paul Railroad Company the right to construct the necessary turnouts and side-tracks at their passenger, freight, and other depots, and to maintain the said tracks forever thereafter for the passage of locomotives impelled by steam, and cars and trains of cars, on the conditions and terms hereinafter specified.

Article 2. Whenever any other road or roads shall obtain permission to enter the city, the right shall be granted to the Davenport and St. Paul Railroad to lay down a second track, as provided for in article 1 of this section, for the purpose of enabling them to comply with the requirements of section 3 of this ordinance.

Article 3. *Provided*, That within two (2) years from the commencement of business by the company a single side-track shall be extended between the limits over which rights are granted for the whole length thereof, viz, from Mound street on the east to Warren street on the west, giving equal facilities for business to all portions of the river-front of the city.

SEC. 2. If to get the track of their road into or out of the city the said railroad company shall find it necessary or expedient to cross over any other of the public streets of the said city in order to reach the levee or steamboat-landings in said city, or to reach said Front street or the river-bank, the right to do so and to lay down and maintain the necessary tracks is also hereby granted to the said railroad company, and a similar right is hereby granted to said company to enable it to connect its track with the Government bridge about to be erected across the river in said city: *Provided, however*, That the said railroad shall not enter the city by any street between Bridge avenue on the east and Marquette street on the west, nor upon the said Bridge avenue or Marquette street.

SEC. 3. The aforesaid grants are not to be exclusive, and the said city reserves to itself the right to make similar grants of privileges to other railroad companies if it shall hereafter desire to do so. If required to do so by the city council, the said Davenport and St. Paul Railroad Company shall extend its said tracks or side-tracks to the steamboat-landing; and shall also transfer the passenger and freight trains of any company hereafter constructing a railroad into the city of Davenport to the respective depots and stations of such company situated on the streets occupied by the track of the Davenport and St. Paul Railroad Company, or to the switches of said companies leading from the Davenport and St. Paul Railroad Company's track within the limits of the city, on equitable terms for the services rendered, to be determined between the parties; but in case any such company and the Davenport and St. Paul Railroad Company cannot agree, each company shall choose a disinterested person, and the city council a third, also disinterested, a majority of whom shall determine the matter so referred, both as to the compensation for motive-power and track-service, and the extent of facilities proper and equitable.

SEC. 4. In consideration of the privileges and rights granted by this ordinance, the Davenport and St. Paul Railroad Company agree with the city of Davenport to observe the following conditions and terms on its part:

1st. That as to rate of speed, conduct of trains, &c., they will be subject to the police and legislative powers of the city of Davenport, provided that no discrimination is made between this and other railroad companies.

2nd. That they will at all times keep the streets they use in good condition and repair, and in no case allow the rails to be above the level of the street, or in any way to prevent the free passage of teams over or on said track.

3d. Wherever any public street which is traveled shall cross the railroad-track, the said company shall keep the crossing in good condition and repair, and shall be liable, and not the city, for all damages caused by failure to do so.

4th. The railroad company, except in case of accident or unavoidable necessity, shall not leave their cars or trains standing on the streets so as to obstruct said crossings, and shall at every crossing erect a sign upon which shall be painted in large letters, "Railroad crossing," and provide a flagman, when requested to do so by resolution of the city council.

5th. While the right to use said Front street and other streets is absolutely granted, yet this right is to be exercised, if the city so requires, under the supervision of the city council, or a committee to be appointed by it, and the desires and wishes of the city as to what part of the streets or bank of the river shall be used for the laying down of the tracks, &c., shall be conformed to by the railroad company.

6th. The rights herein conferred upon the said company are granted upon the expectation and understanding that the said company will faithfully observe the aforesaid conditions, and will at all times, and in good faith, to the extent of its power, afford adequate facilities to the business men of the city for the prompt transaction of business, and will in all things deal and act justly towards the city and the citizens thereof.

SEC. 5. If, instead of using Front street proper, as provided in the first and second sections hereof, the said railroad company shall prefer to use the bank or shore of the river, in whole or in part, the city hereby grants to it the right to do so, on the terms and conditions hereinbefore mentioned: *Provided*, That in so doing it does not interfere with or obstruct the steamboat-landing of said city.

SEC. 6. The city will lease, on reasonable terms, to the said company a suitable portion of the levee, to be determined hereafter between the city council and the railroad company, for station and depot buildings, said terms to be agreed upon by the city authorities and company. If the parties hereto cannot agree, each will select an arbitrator, and the two a third, whose award, subject to the approval of the judge of the district court, shall be binding.

SEC. 7. This ordinance is not repealable at the will of the council, but may be repealed if it is first judicially ascertained, in a suit brought for that purpose, that the railroad company is failing, after notice from the city, substantially to perform the terms and conditions on which the rights herein conferred were granted. While the city cannot repeal this ordinance except as above, it still retains, in all other respects, its usual and lawful corporate and legislative powers, and the right to make ordinances to enforce and compel the said company to keep and perform this ordinance in letter and spirit, anything in this section to the contrary notwithstanding. The city may repeal this ordinance if the cars of the said railroad company shall not be in active operation in this city within five years from this date, which fact the city council may determine for itself without resort to judicial proceedings.

SEC. 8. The franchises and privileges granted by this ordinance are not to be transferred to or to be used by any individual, company, or other railroad corporation without the previous assent of the city council through an ordinance regularly passed after ten (10) days' publication in full of said ordinance in the official newspaper of the city, except in case of sale by foreclosure of mortgage on unpaid bonds, in which event all the rights and privileges herein conferred, together with the limitations and conditions, will pass to the purchaser without further ordinance.

Passed and approved May 11th, 1870.

JOHN M. LYTER, *Mayor.*

REGULAR MEETING, *February* 15, 1871.

AN ORDINANCE enabling the Chicago, Rock Island and Pacific Railroad Company to connect their road with the Government railroad-bridge.

Be it enacted by the city council of the city of Davenport:

SECTION 1. In consideration of the performance of the conditions hereinafter specified, the right and permission are hereby granted to the Chicago, Rock Island and Pacific Railroad Company to connect their road with the Government bridge, by erecting bridges across Third and Fourth streets, and the alleys intervening between the bridge and railroad in said city, in the manner hereinafter specified.

SEC. 2. That the Chicago, Rock Island and Pacific Railroad Company in erecting their bridge across Fourth and Rock Island streets in this city to connect their railroad with the Government bridge now being built across the Mississippi River, be, and they are hereby, authorized to erect it so that the bottom of the lower chord be at least eleven feet above the grade (as now established) of said streets at the place of crossing, upon the condition that said company shall be required, at its own expense, to lower the grade of said streets in such manner as the city council shall direct, and as shall be requisite and necessary to create a proper space between the surface of said streets and the bottom chord of said bridge, for the convenient passage of all teams and vehicles with their loads, which ordinarily travel in the streets of the city; and shall pay all damages that may be occasioned by the change of said grade, to the property-owners or to the city. And that in constructing said bridge (for the purpose of shortening the span) the said company shall be authorized to erect an iron pillar on the outer

edge of the sidewalk on Fourth street east of Rock Island street, and one on the outer edge of the sidewalk on Rock Island street north of Fourth street, to support one of the chords of said bridge.

SEC. 3. That in building the bridge across Third and Iowa streets to make the connection as aforesaid, the said company shall be, and is hereby, authorized to erect an iron pillar on the outer edge of the sidewalk on Third street east of Iowa street, and on the outer edge of the sidewalk on Iowa street north of Third street, to support one of the chords of said bridge. The said pillars to be so erected, as provided by this ordinance, shall be placed and erected according to the plan as shown by a drawing thereof submitted by the said company and filed in the office of the city engineer.

SEC. 4. These privileges and the rights to cross the streets and alleys of the city in forming said connection are granted upon the express condition that said railroad company shall not, in any manner, obstruct the approaches to said Government bridge any more than is necessary for their railroad track or tracks so as to prevent any other railroad company desiring to do so from gaining access to said bridge over the lands of said Chicago, Rock Island and Pacific Railroad Company.

SEC. 5. The said company shall signify its acceptance of the conditions of this ordinance to the mayor of the city within thirty (30) days from the passage of this ordinance, which said acceptance is a condition-precedent to the rights and privileges herein granted.

Passed and approved February 15, 1871.

JOHN C. BILLS, *Mayor.*

REGULAR MEETING, *December* 6, 1871.

A SUPPLEMENT to an ordinance entitled "An ordinance granting the right of way and certain privileges and rights to the Davenport and St. Paul Railroad Company," passed and approved May 11, 1870.

Be it enacted by the city council of the city of Davenport:

SECTION 1. That in addition to the rights and privileges granted to the Davenport and St. Paul Railroad Company by the provisions of an ordinance passed and approved on the 11th day of May, 1870, entitled "An ordinance granting the right of way and certain privileges and rights to the Davenport and St. Paul Railroad Company, there is hereby granted to the said company the right to construct its road on and along College avenue from its intersection with Locust street to a point at or near the south line of lot number 29 of block 5 of Fulton's addition; thence by some convenient route by way of, on, and along North Depot street and the extension thereof through block 71, to a point at or near the intersection of Fifth and Rock Island streets; and thence along Fifth street westward as far as it shall be necessary for the purpose of switching its trains upon the approaches to the new Government railroad-bridge now being erected across the Mississippi River, and upon the track connecting the line hereby authorized to be constructed, with that authorized by the provisions of the ordinance to which this is a supplement, to be constructed along the river-bank and Front street; and for the purpose of enabling the said company to connect its road with the line and the proposed depots and warehouses provided for in the ordinance to which this is a supplement, there is hereby further granted to the said company the right to construct a tract from or near the said intersection of Fifth and Rock Island streets by way of, on, and along North Depot street and the extension thereof, through block 71 and Federal street, so far as the same shall be necessary, to a point at or near the intersection of the said last-mentioned street with Front; and thence along Front street to its intersection with Second street; thence along Second street to or near the point of its intersection with Iowa street; thence along Iowa street to Front street, between Iowa and Rock Island streets; thence along Front street to the east line of Rock Island street.

SEC. 2. If it shall be found necessary, for the purpose of connecting the said company's track with the said Government bridge across the Mississippi River, to construct approaches in whole or in part, independent of those now being constructed by the Chicago and Rock Island Railroad Company, there is hereby further granted to the said Davenport and St. Paul Railroad Company the right to construct its said approaches on and along Rock Island street from Fifth street to Fourth street.

Proceedings of the city council.

SPECIAL MEETING.

COUNCIL CHAMBER, May 26, 1870.

Be it enacted by the city council of the city of Davenport:

SECTION 1. That the right is hereby granted by the city of Davenport to said William B. Ross, as trustee for the bondholders of the Davenport and St. Paul Railroad Company,

to lay down in said city a single track of its said road, commencing at a point on the west line of Spring street, which said point is thirty-two (32) feet north of the line of a public highway, known as the Davenport and Le Claire road or Front street, running thence southwesterly along the said Davenport and Le Claire road or Front street to a point on the south line of said road or Front street, not to exceed one hundred (100) feet west of the west line of a building known as Severn's brewery; thence continuing southwesterly along the bank or shore of the Mississippi River to a point south of Shields's woolen-factory; thence along the bank of the Mississippi River, on the south of Daniel Gould's furniture-factory and Renwick's saw-mill, to a point on the levee opposite the south side of Third street, where said Third street intersects the Davenport and Le Claire road or Front street; thence along the levee or river-bank to Farnam street; thence crossing Front street to the alley in block seventy-five, (75;) thence along said alley, across Le Claire street, on the north side of the Government bridge, to and across Second street and Iowa street to Front street, at a point east of Rock Island street; thence along the south side of said Front street and the levee to Warren street: *Provided, however*, So far as the city council may have the power so to do, it consents that said line may be extended from said point opposite the east end of Third street, along the river-bank and Front street, to a point forty-six (46) feet south of the land-pier of the new railroad-bridge; thence to the south side of Front street, at a point east of the west line of Iowa street, where said Iowa street extended would strike the river; thence along said Front street to Brady street; thence along the levee and Front street to Warren street; and if, in crossing the approach to said Government bridge 46 feet south of said land-pier of said bridge, which must be done at grade, it shall become necessary for the owners of said railroad to raise the grade of the said Front street on both sides of said crossing above the grade of any of the streets so run over, along or across, it shall be the duty of the owners of the said road to provide and complete such approaches to such crossings in a manner as set forth in section three (3) of this ordinance; and in case such fills or crossings may, in any manner, obstruct the free passage of water on its way to the river, good and sufficient stone sluices shall be built under said railroad at proper distances to carry away such water; and in case of damage to private property arising from making such fills for approaches, or on account of any change of grade being made necessary, the owners of said road shall be liable therefor, as provided in section four (4) of this ordinance: *Provided*, That the said railroad-track between the old railroad-bridge and Farnam street shall be at least seventy feet south of the north line of said Davenport and Le Claire road or Front street; and between Brady and Ripley streets the track shall be at least eighty feet from the north line of said Front street, and from thence to Warren street such a distance as the city council may hereafter determine: *Provided, also*, That the said road shall be entitled to build such necessary switches and side-tracks to such warehouses, mills, and manufactories as the said railroad company desires to reach, when the owners have previously obtained the consent of the council to the use of such facilities; and, also, the right to construct side-tracks to the steamboat-landing between Harrison and Perry streets; and there is also hereby granted to the said owners of said railroad the right to construct the necessary turnouts and side-tracks at their passenger, freight, and other depots, and to maintain the said tracks forever thereafter for the passage of locomotives propelled by steam, and cars and trains of cars, on the conditions and terms hereinafter specified: *Provided, also*, That the city expressly reserves the right to grant similar rights and privileges to other railroads; and when such grant is made by the city council to any other railroad or company along the river-bank or streets or levees herein named, then such railroad or company shall have the right to use the track of the said Davenport and St. Paul Railroad through the said city for the passage of cars and trains of cars, upon adequate compensation being made therefor, and upon reasonable terms, to be agreed upon by the owners of said roads; and in case of a disagreement, then the matters in difference are to be determined by three arbitrators—one to be chosen by each of said owners, and the third by the city council: *Provided*, That when such privileges are granted to another railroad or company, the owners of the railroad herein named shall have the right, and the privilege is hereby granted to it or them, to construct an additional track adjacent to and immediately south of the line of the track herein named, to be in every way constructed on the terms and conditions as herein provided for the first line, and to be subject to like use by other companies, or the city council may grant such right to another company to construct such track: *Provided*, That said tracks of said railroads must cross Spring street, so as to leave a space or span of at least sixty feet for a public road or highway, at a height of not less than fourteen feet in the clear above the established grade of said road or highway.

SEC. 2. That the owners of the said railroad shall procure, at their own cost and expense, a conveyance to said city of Davenport, for the purpose of a public street or highway forever, of so much real estate on the north line and adjacent to said Davenport and Le Claire road or Front street, as is included in the following description, to wit: Commencing on the west line of Spring street, one hundred and twenty (120) feet

north of the north line of the said Davenport and Le Claire road or Front street; thence southwesterly to the west line of D. N. Richardson's land, forty-four (44) feet north of the north line of said Davenport and Le Claire road or Front street; running thence southwesterly to the west line of Nathaniel Squires's property, forty (40) feet north of the north line of said Davenport and Le Claire road or Front street; thence continuing southwesterly through Brabrook's land to a point where the north line of said Front street, running through Fulton's addition, intersects the township-line between ranges three and four (3 and 4) east of the fifth P. M., being all the real estate lying between the foregoing-described line and the Davenport and Le Claire road or Front street. It being the intention herein to require the owners of said railroad to widen said highway at the north side thereof and between the points aforesaid at the expense of said railroad or owners thereof, and without cost or expense to the city, so as to have the north line of said highway, when so widened, as far from the outer edge of the north embankment of said railroad-track as the present width of said highway, thereby leaving said highway at least sixty (60) feet in width, and to furnish said newly-built road or street with macadam in the manner and to the extent that the corresponding portion of the present road or street is now macadamized; and also to build a sidewalk equal to the present sidewalk, and to provide all proper and necessary sluice-ways under the track of said road for carrying away the water from above its line; and the said track of said railroad shall not be laid on said Front street at or within the points aforesaid, until said conveyance or conveyances shall be executed and recorded, and said real estate fully dedicated or set apart to the public as and for a highway, and graded, improved, and put in good condition for travel as a street, and as such accepted by the city.

SEC. 3. If it shall become necessary for the owners of said railroad to carry the track across said Davenport and Le Claire road or Front street, which right is herein granted, at said point near said old railroad-bridge, above the present grade or surface of said road, in order to connect the track of said railroad with the Government bridge, it shall in that event become the duty of said owners to fill up and raise said Davenport and Le Claire road or Front street, throughout its entire width, from the point where said track crosses said Front street, each way on both sides, to such a distance from said crossing that the grade or surface of said Front street shall not exceed one and one-half (1½) feet in one hundred (100) feet, and shall macadamize the same as far as said fill in said Front street extends to the depth of at least twelve (12) inches over the entire surface of said street, and shall also fill up and raise Fourth street from its intersection with said Front street near said old railroad-bridge to Dupage street, so as to leave the entire surface of said street uniform between said points, and shall forever keep the said track so passing to the Government bridge thoroughly planked between its rails, and on the outside of its rails to the ends of the ties on either side, at all points where there are public highways crossing said track. And the said owners of said road shall also fill up and macadamize with at least one foot of macadam between the track of said road and the Mississippi River, all along the levee already constructed by the city of Davenport, in front of said track, so as to make the said levee easily accessible for teams and wagons to and from said levee across railroad-track, and shall from time to time, as ordered by the city council, wherever said track occupies any portion of the levee now or hereafter improved, or occupies or crosses any street or alley, thoroughly plank the track of said railroad as well as the ties on the outside of said rails.

All to be done at such points and places as the council may direct, and in such complete and serviceable manner as that all sorts of vehicles can pass over said track without impediment, and shall be liable for all damages caused by a failure so to do; and in addition thereto, if said owners shall fail upon being notified so to do, the city shall have the right to make such improvements and recover the cost and expense thereof from the said railroad or owners, by suit at law.

SEC. 4. And the said owners of said railroad shall be liable to the city of Davenport for all damages occasioned by their use of the street, or any other real property, or changes of grade herein authorized, whether such damages are sustained by property-owners or other persons; and said liability to said city of Davenport shall be the same in all respects and to the same extent as the said city of Davenport shall or may become liable to any third parties from such use of said streets, alleys, levees, or other real property. And it is herein and hereby agreed and understood that the city of Davenport grants by this ordinance no rights, titles, or privileges that are not at this time absolutely and unquestionably in its lawful possession.

SEC. 5. The said owners of said railroad shall be liable to the Davenport City Railroad Company for all damages sustained by said latter company in consequence of the construction of said railroad across or along said Davenport and Le Claire road or Front street, and the filling up of said street and operating said railroad; and the said owners of said railroad shall at their own cost and expense replace the track of said Davenport City Railway Company, and shall construct said track of said railroad in such a way as to leave a passage for the tracks of said street-railway under said rail-

road between the east line of Spring street and the west line of Brabrook's property in as good condition as it now is, whenever requested to be removed, and shall indemnify and keep the city of Davenport harmless and free from all costs and damages for which the city of Davenport may or shall become liable to the said Davenport City Railway Company, in consequence of the use of said Front street by said railroad as is or may be authorized by this ordinance or the ordinance passed and approved May 11th, 1870.

SEC. 6. While the right to use said Front street and other streets is absolutely granted, yet this right must be exercised under the supervision of the city council or a committee appointed by it, and the desires and wishes of the city as to what part of the street or bank of the river shall be used for the laying down of the tracks, &c., (except where line of said track is definitely described in this ordinance,) shall be adopted and conformed to by the owners of said railroad.

SEC. 7. The rights and privileges shall vest in the owners of said railroad, upon said owners for themselves, assignees, or successors filing with the clerk of the city a written acceptance of all the provisions, terms, and conditions of this ordinance, as well as the ordinance of May 11th, 1870, being chapter 47 of the revised ordinances; and it is expressly understood and agreed that if said road is not fully completed as far west as the old railroad-bridge by the first day of December, 1876, and the balance thereof by June 1st, 1877, that the city reserves the right to repeal this ordinance as well as said chapter 47 of the revised ordinances at pleasure.

SEC. 8. In consideration of the privileges and rights granted by this ordinance, the owners of said road agree with the city of Davenport to observe the following conditions and terms on its part:

1st. That as to rate of speed, conduct of trains, &c., they will be subject to the police and legislative powers of the city of Davenport, provided that no discrimination is made between this and other railroad companies.

2nd. That they will at all times keep the portions of the streets they use in good condition and repair, and in no case allow the rails to be above the level of the street or in any way to prevent the free passage of teams over or on said track, and during the building of said railroad the builders shall not be permitted to advance its line for more than one thousand (1,000) feet, unless otherwise ordered by the city council or a committee by the council appointed, until the one thousand feet first preceding thereto shall have been completed in all respects as fully provided for in and by this ordinance.

3rd. The railroad company, except in case of accident or unavoidable necessity, shall not leave their cars or trains standing in the streets so as to obstruct said crossings, and shall at every crossing erect a sign, upon which shall be painted in large letters "Railroad crossing," and provide a flagman when requested to do so by resolution of the city council.

4th. The rights herein conferred upon the said company are granted upon the explicit understanding that the said company will faithfully observe the foregoing conditions, and will at all times, and in good faith and to the extent of its power, afford adequate facilities to the business-men of Davenport for the prompt transaction of business, and will in all things and at all times deal and act justly towards said city and the citizens thereof.

SEC. 9. The city will lease on reasonable terms to said company a suitable portion of its levee, to be determined between the city council and the railroad company, for station and depot buildings; said terms to be agreed upon by the city council and the said company. If the parties hereto cannot agree, then each will select an arbitrator, and the two a third, whose award shall be final.

SEC. 10. That while the city council has now the right and power to repeal chapter 47 of the revised ordinances of 1875, being an ordinance entitled "An ordinance granting the right of way and certain privileges and rights to the Davenport and St. Paul Railroad Company," passed May 11th, 1870, by reason of the failure of the said company to have its road in "actual operation in the city" within five years from the passage of said ordinance, it does not avail itself of such right, further than to repeal so much of said ordinance as conflicts with the provisions hereof: *Provided*, That if the said railroad is not completed within the time and manner required by section 8 hereof, the council shall have the right to repeal the same at pleasure.

SEC. 11. That chapter 48 of the revised ordinances of 1875, being an ordinance entitled "An ordinance designating and defining the line of the right of way granted to the Davenport and St. Paul Railroad Company," &c., &c., passed and approved July 30th, 1873, be, and the same is hereby, repealed.

Passed and approved May 26, 1876.

RODERICK ROSE, *Mayor.*

Attest:

J. G. TUERK, *City Clerk.*

On motion of Alderman Stevenson the council adjourned.

J. G. TUERK, *City Clerk.*

ROCK ISLAND ARSENAL, ILLINOIS,
Sept. 30th, 1876.

Col. J. N. MACOMB,
U. S. Engineer Corps, Rock Island:

SIR: Will you be kind enough to furnish me with official copies of any correspondence or papers you may have showing any action taken by the city council of Davenport granting to the United States the privilege of landing and constructing the approach of the "Rock Island bridge," in the city of Davenport?

I will be much obliged to you for any papers having any bearing on or relation to this subject, and, also, if there was any action taken verbally which would tend to confirm or destroy the right of the United States to the use of the land occupied by the approach. I would be greatly obliged to you for any statement in writing or information relating to such conversations that you can give me. I would be very much obliged to you for an early reply. My object in applying for this information is to obtain the means as far as possible of protecting the property and interests of the United States in the bridge and its approach.

I cannot find among the papers relating to the bridge, turned over to me by you, any information on this subject.

I have the honor to be, very respectfully, your obedient servant,

D. W. FLAGLER,
Major of Ordnance, Bvt. Lt. Col. U. S. A., Comdg.

Respectfully referred to Capt. Amos Stickney, who is requested to furnish any information he may have, from memory or otherwise, bearing on the subject of this letter.

J. N. MACOMB,
Col. Engrs., U. S. Army.

P. S.—An early reply is respectfully asked.

U. S. ENGINEERS' OFFICE,
Keokuk, Iowa, October 9th, 1876.

Respectfully returned to Colonel J. N. Macomb, Corps of Engineers. I am not aware of the existence of any correspondence or papers showing action taken by the city council of Davenport granting to the United States the privilege of landing and constructing the approach of the Rock Island bridge, in the city of Davenport. If any such correspondence passed during the time the bridge was under the control of the Engineer Department, it will probably be found in the possession of Genl. G. K. Warren, Corps of Engineers, to whom, as you will probably remember, the letter-books of the earlier transactions of the bridge-work were sent. General Warren, with whom I conferred yesterday, states that according to his recollection, the only action of the Davenport City council in connection with the bridge related to changing of grade of the streets in that vicinity.

AMOS STICKNEY,
Capt. of Engrs., U. S. A.

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., October 27, 1876.

Colonel D. W. FLAGLER,
U. S. Ordnance, Rock Island:

COLONEL: I send you the copy of my communication to the mayor of Davenport, dated August 18, 1869, and of his reply of next day's date.

There was no special understanding about obstructing the approach, but in conceding us the location and change of grade, which latter was made at the public expense, it seems to me implied they would not authorize any obstructions on the approaches.

You will see that I stated that the railroad was to be on top, and I informed them that a 500-foot curve would allow any other railroad to get on to the bridge; I suppose implied thereby that I thought any other railroad would keep on the high grade the same as the Chicago and Rock Island Road, and not interfere with the wagon-road.

The council was anxious that I should not terminate the wagon-road on the railroad block, as General Rodman's plan did, allowing, as they thought, an opportunity for the Chicago and Rock Island Company to obstruct the wagon-approaches.

It seems strange that in acceding to their views to prevent the railroad company from obstructing the approach, they should have reserved the right to allow any other railroad the privilege of doing it.

It seems to me that if the city of Davenport now claims such right, the United States would be justified in threatening retaliation by closing the bridge altogether to any but the necessities of the United States arsenal.

Very respectfully,

G. K. WARREN,
Major Engineers.

U. S. ENGINEER'S OFFICE,
Davenport, Iowa, August 18, 1869.

To Hon. JAMES RENWICK,
Mayor of Davenport:

SIR: I have nearly determined upon my location and plan of the new bridge, but before doing this as a finality I wish to be informed if the city council will give its consent to have the grade at the intersections of Le Claire street, Front street, and Second street raised about six feet. There is a snubbing post near this point on the bank that I should have to cover the top of about one foot. This six feet height can run out to nothing about 200 feet above and below on Front street, and the same distance on Le Claire and Second streets, and give grades that will be as easy as is desirable. I can then rise to the level of the bridge on a grade of one upon twenty, by placing the abutment pier about on the line of low water. The bridge floor will be twelve feet above high water, so that the bottom may be ten feet above high water. I send a map and profile which exhibit the proposed arrangement. The center line of the bridge meets the center line of Le Claire street. It may be better to move this up or down a few feet hereafter, but it will not change the general features. In this position a railroad along Le Claire street, along Second street, or up Front street could use a five hundred feet radius to the curve in getting on the bridge.

You will see that if Flatiron square was built out to the full line, the sidewalk would occupy all the present roadway at the lower end. I have marked out the line of the other side of Front street, if it is ever banked out, to be eighty feet wide. My design is for the railroad on top.

The filling up will not affect the drainage of any street but Le Claire street, and a culvert must be put in to keep up the drainage. There is no building of value to be injured by this change of grade, and the advantages the location of the bridge gives the property must enhance it more than any cost of filling up would be.

In this plan I shall save about one hundred and ninety feet of wagon road bridge of what would be required by terminating the bridge on the railroad block at the corner of Le Claire and Second streets.

Besides, in locating the abutment at low water line, I allow the use of a full span next the landing for the use of rafts, and get the first pier well out of their way, which is important in constructing the pier and its future avoidance by raftsmen.

It is not fully decided yet where the pivot pier is to be placed, but if next to the island, there will be, beside the two draw spans of 160 feet in the clear, the next span of 250 feet in the clear, and four other spans of 220 feet in the clear. The accompanying sketch and profile will more fully show the approach on the Davenport side, to which I call special attention. It is drawn, as this letter is written, in haste, so as to bring the matter before you as early as possible.

Yours, respectfully,

G. K. WARREN,
Major Engineers and Bvt. Maj. Gen. U. S. A., in charge of Bridge, &c.

COUNCIL CHAMBER, *Davenport, Aug. 19th*, 1869.

To General WARREN:

DEAR SIR: Your communication, together with profile, were laid before the council last evening, when it was unanimously resolved that the grade rising six feet at the post mentioned, as shown by the diagram and required according to your plans, be freely conceded, and also that you be officially informed of said action of council.

Yours, very respectfully,

JAMES RENWICK, *Mayor.*

[Telegram.]

ROCK ISLAND ARSENAL, *October* 27, 1876.

Hon. JAMES T. LANE,
U. S. District Court, Des Moines, Iowa:

Please telegraph me what action has been taken and what progress made respecting injunction against Davenport and Saint Paul Railroad Company.

FLAGLER, *Comdg.*

[Telegram.]

DAVENPORT, IOWA, *October* 28, 1876.

JAMES T. LANE,
U. S. Atty., Des Moines, Iowa:

Telegraphed you yesterday. What action has been taken respecting injunction against Davenport and Saint Paul Railroad Company. Please answer.

D. W. FLAGLER,
Bvt. Lt. Col., Comdg.

[Telegram.]

DES MOINES, IOWA, *October* 28, 1876.

Col. D. W. FLAGER,
Rock Island Arsenal, Rock Island, Ill.:

Injunction suit submitted to court this evening. Decision will be telegraphed when announced by the court.

JAMES T. LANE,
U. S. Atty.

OFFICE OF UNITED STATES ATTORNEY, DISTRICT OF IOWA,
Davenport, October, 30th, 1876.

SIR: The application for injunction against the Davenport and Northwestern Railroad Company was submitted to the court on Saturday, and no decision was announced at the time I left Des Moines on Saturday night, and if announced to-day, it will be telegraphed to me. I return again to-night, and will notify you of the result.

I have not much hope of success, as I have serious doubts whether a proper cause for injunction can be shown. The reason for delay in the application is that I did not receive the papers until we entered upon the trial of the Rhomberg whisky suit, and my time was completely occupied with that until Friday night, and the earliest moment I could take it up was on Saturday morning, and I passed it on the court, and could not get a hearing until late in the afternoon. I regret very much the delay, inasmuch as I learned on my arrival yesterday that the track was already laid. The understanding with the officers and attorneys of the railroad company was that it would not be laid until after a hearing.

Very respectfully,

JAMES T. LANE,
U. S. Attorney.

Col. D. W. FLAGLER,
Rock Island Arsenal, Illinois.

[Telegram.]

DES MOINES, IOWA, *October* 31*st*, 1876.

Col. T. W. FLAGLER,
Commanding Rock Island Arsenal, Rock Island, Ills.:

Judge Love refused to open an injunction against the railroad company for laying its track across the approach to the Government bridge.

JAMES T. LANE,
U. S. Atty.

This road has been built across the approach, and is now in full operation.

For a further history of the Rock Island bridge from 1873 to 1876, see copies of annual reports of principal operations at the Rock Island arsenal for the year ending June 30, 1873, 1874, 1875, and 1876, copied in Appendices B, C, D, and E, Chapter VIII, of this book.

These reports give a good deal of information respecting the use of the bridges by the public, and the report for the year ending June 30, 1875, gives a full account of some extensive repairs of the bridge and alterations of machinery which had been found necessary.

In addition to repairs described in the report, the Rock Island bridge has received two new floors since 1871, and the bridge to Davenport has had a great part of its wagon way refloored since it was completed in the spring of 1873.

This bridge needs now an entire new floor.

The following correspondence and action taken by Congress respecting the appropriation for the new covering of the railroad deck and new machinery for the draw is not given in the annual reports, and is therefore copied here.

The following estimate was made in the annual estimate for the year ending June 30, 1875:

For alterations and repairs and additional machinery for draw	$13,400
For care and preservation	10 000

with the following remarks:

The alterations and repairs required consist of a sheet copper roof for the upper or railroad deck, as shown in drawing marked "B," and inclosed herewith, and more powerful machinery for working the draw.

When the bridge was built, there was put on this deck a flat tin roof, with no water shed except that furnished by the camber in the spans, about one inch in 200 feet, and water shed is further prevented by the railroad ties and wheel guards which are laid on the roof.

The water is not shed from the roof. In a few months it has rusted and destroyed the tin, and now runs through and is rotting the timbers of the upper deck and the wagon road below. As both decks have wooden floor beams, their destruction is a serious matter, involving the disuse of the bridge while the whole deck is renewed.

The drip of water continues about three hours after any rain or shower, and not only rots the timber, but the water, containing iron rust, grease, and dirt, falls on people and carriages below, who, in fine weather, after rain, are unprepared and unprotected, and who, having entered the bridge, cannot turn back.

I do not deem it advisable or economical to put any cheaper roof than copper on this deck.

In this climate, tin, lead, or galvanized iron can be made to last only from five to ten years in this position, and their removal is difficult and expensive. The copper should last from thirty to fifty years.

The machinery in use for working the draw is insufficient in power, and has, in consequence, broken three times in the last four months, with careful management. Also, some additional machinery is required for stopping the draw when in motion and operated upon by high winds.

The cost of putting in the new roof would be	$23,000
The cost of additional machinery	3,800

The railroad company or companies using the bridge should, under their agreement, pay half the expense.

The estimate for care and preservation includes all ordinary repairs and guard, but is mainly for operating the draw. This work requires two sets of hands, each containing an engineer and fireman, and they must be the best men I can procure. The work is difficult and the responsibility is great.

The following appropriation for the Rock Island bridge for the fiscal year ending June 30, 1875, was made by Congress:

For alterations and repairs and additional machinery for draw of bridge, and for care and preservation (one-half of which shall be re-imbursed to the Government by the Chicago, Rock Island and Pacific Railroad Company) $23,400.00.

The Chief of Ordnance, in a letter dated October 22, 1874, inquired if measures had been adopted for obtaining re-imbursements by the Chicago, Rock Island and Pacific Railroad Company of $11,700 of the appropriation for Rock Island bridge, 1875, required by the appropriation act, as published in General Orders No. 81, Adjutant-General's Office, 1874.

On the 26th of October, 1874, I replied to the above letter as follows:

I have the honor to acknowledge the receipt of your letter of the 22nd instant, asking if any measures had been adopted for obtaining re-imbursement from the Chicago, Rock Island and Pacific Railroad Company of $11,700 of the appropriation for Rock Island bridge for 1875, and, in reply, to state that I have not communicated with that company on the subject, since the plans and estimates for the repairs of the bridge were laid before the superintendent of the company when I was making my annual estimate in July, 1872.

The prosecution of the work on the railroad-deck of the bridge would necessitate interference with crossing of trains.

As there is a pressure of traffic on the bridge during the fall, it was deemed more convenient for the railroad company to postpone this interference until spring. Also, I would have more time in the spring to attend personally to the alterations and repairs, which involve some difficulty; therefore it was deemed expedient to postpone the work until spring, or the latter part of winter.

Nothing, therefore, has yet been done in the matter, except to take advantage of the exceptionally low price of copper and purchase the sheathing required for the upper deck.

The tenor of your letter leads me to infer that there has been a misunderstanding of the intention of the act of Congress making the appropriation. The estimate showed that the cost of the proposed alterations and repairs would be $26,800, and one-half of that sum, $13,400, which was the portion of the expense the United States would have to bear, was asked for and appropriated.

Separate from this was an estimate for $10,000 for care and preservation, which is the portion of the expense of care and preservation which the United States has to bear.

As the act appropriates exactly the sums asked for, namely, $13,400 and $10,000, I have supposed it authorized the expenditure of the money as intended; that is, the Government to expend the $10,000, required to cover its portion of the expense of care and preservation in accordance with act of Congress approved July 20, 1868, and also the appropriation of $13,400 for the special work of alterations and repairs.

I have expected to make arrangements with the Chicago, Rock Island and Pacific Railroad Company for the payment of their portion of the expense of this work, $13,400, before commencing the work.

In case of refusal on their part, which I do not now anticipate, I believe that the act of July 20, 1868, and the contract between the Government and the railroad company, would empower the Government to enforce the payment by denying the railroad company the use of the bridge.

If it is understood that there is anything in the act making the appropriation which may prevent the use of the money appropriated for making the repairs as stated above, and as intended in the estimate, I respectfully ask for instructions.

The Chief of Ordnance returned this letter with the following indorsement, dated November 10, 1874:

Respectfully returned to the commanding officer of Rock Island arsenal.

As Congress, in making the appropriation, added a proviso which was not in our estimate except as an explanatory note, (see Ordnance Order No. 44,) it is plain that only the $23,400 appropriated can be expended, one-half of which must be re-imbursed by the railroad.

The matter can be brought to the attention of Congress when it meets, and the proviso requested to be changed.

I returned this letter to the Chief of Ordnance with the following indorsement, dated November 18, 1874:

I respectfully ask that this matter may be brought to the attention of Congress, and that the proviso referred to may be changed as contemplated in your indorsement hereon, and would respectfully urge the importance of this action.

The alterations and repairs contemplated are deemed absolutely necessary for the preservation of the bridge.

Without them there is danger of the destruction of the floor-beams of both decks because of rot. Replacing these beams would be difficult and expensive, and would necessitate several weeks' disuse of the bridge.

If Congress will change this proviso early in the session, preparation for the work can be made during the winter and the work completed early in the spring. The necessary change in the proviso is that it shall apply only to the proposed alterations and repairs, and that it shall require the railroad company to bear one-half the expense of the work, as required by act of July 20, 1868, and the contract between the United States and the railroad company.

Your indorsement hereon makes the proviso referred to in the appropriation act to interfere also with the expenditure of the $10,000 appropriated for the care and preservation of the bridge.

Without the use of this money the use of this bridge would stop, and the navigation of the river would also have to stop, because the draw could not be operated. This expenditure on the part of the United States is made obligatory by the act of July 20, 1868, and the contract with the railroad company, as long as the company complies with the contract. The act and contract referred to require the United States to bear all the expense of the wagon-road and one-half the expense of the bridge, (except railroad iron and ties,) so that the railroad company cannot be required to pay half of the whole expense.

During the present fiscal year there has already been expended by the United States, for care and preservation, $4,359.57; the proposed alterations and repairs in purchase of sheathing for upper deck, $5,971.62.

In a letter to the Chief of Ordnance, dated December 18, 1874, I inquired if item of $13,000 for the Rock Island bridge was intentionally omitted from notice of remittance. To which the following reply, dated December 22, 1874, was received:

Answering your letter of the 18th of December, I am directed by the Chief of Ordnance to state that the omission of $13,000 under "Rock Island bridge, 1875," from the amount requested to be sent, was intentional. Expenditures on account of the "repairs and machinery" of the bridge must be suspended until Congress has acted upon the subject-matter of your letter and indorsements of October 26 and November

18, which was brought by this office to the attention of the Secretary of War on the 16th inst.

Expenses of the bridge must be confined to the operation of the guard, draw, &c., until the appropriation of last year is freed by Congress of the restriction proviso.

Subsequent thereto an act of Congress was passed, and approved March 3, 1875, appropriating "for Rock Island bridge: for care and preservation of the bridge, thirteen thousand dollars. And this sum and the appropriation for said bridge for the fiscal year ending June 30, 1875, shall be expended in accordance with the joint resolution in relation to the Rock Island bridge, approved July 20, 1868, and the contract between the United States and the Chicago, Rock Island and Pacific Railroad Company."

The following statistics, compiled from records kept at the bridge, are valuable as general information and as special information relating to value of bridge in its use by the public and by the railroad company:

Compilation of Rock Island bridge record for the years 1874, 1875, *and* 1876.

Date.	Stage of water.			Thermometer.			Number of trains crossing bridge.			Passengers and teams.*		Steamboats, barges, and rafts passing draw.		
	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Engines.	Passenger cars.	Freight-cars.	Passengers.	Teams.	Steamboats.	Barges.	Rafts.
1874.														
January	11.30	7.30	8.40	62	−15	22.17	213	717	8,870	.....	.....	.....	...	...
February	7.55	6.15	6.66	50	−10	25.22	197	646	7,467	13,994	10,901	.....	...	...
March	15.75	5.30	8.27	65	11	37.81	218	704	8,773	40,507	20,905	32	19	5
April	7.05	4.30	5.10	85	18	43.80	262	741	11,565	29,083	16,827	131	51	34
May	8.15	5.90	7.43	97	41	70.19	257	780	11,291	31,656	19,941	311	65	115
June	6.95	4.40	5.51	98	53	78.10	242	743	9,632	29,635	17,793	276	51	142
July	7.05	4.00	6.22	101	66	82.23	226	806	8,122	35,612	19,452	236	19	97
August	3.85	1.65	2.28	98	64	78.53	261	767	11,453	35,250	20,595	244	86	63
September	4.30	2.00	3.04	92	42	68.91	288	818	9,810	31,064	22,852	228	61	65
October	5.20	3.15	4.40	86	28	53.27	301	836	11,487	29,999	23,360	151	56	50
November	4.45	2.10	3.59	74	4	36.56	603	716	10,700	30,273	19,117	63	39	12
December	3.25	.40	1.95	58	−10	27.58	707	814	11,605	31,713	20,197	.....	...	...
Total	.....	.....	.....	...	...	.....	3,725	9,088	120,775	338,786	211,940	1,672	447	583
1875.														
January	8.75	2.70	6.28	38	−22	8.52	1,021	1,015	11,259	16,063	11,758	.....	...	...
February	5.30	3.90	4.38	37	−17	11.41	637	652	9,618	9,087	5,097	.....	...	...
March	13.10	3.80	4.74	78	+ 1	30.93	719	764	11,404	32,585	13,218	.....	...	...
April	12.95	7.95	9.47	80	17	48.59	652	771	10,639	34,696	18,420	133	30	29
May	12.70	8.10	9.92	89	28	65.01	627	770	11,024	32,147	17,143	269	29	107
June	8.10	6.90	7.34	98	52	72.34	610	781	10,957	27,480	18,930	271	80	114
July	7.90	2.50	5.28	92	62	78.77	539	797	9,823	27,876	18,388	264	59	97
August	2.50	1.10	1.60	90	46	73.95	559	769	10,027	35,858	24,303	318	143	105
September	7.05	1.10	4.89	92	34	64.78	614	843	10,679	24,554	24,000	280	139	68
October	4.70	2.20	2.89	77	27	48.99	647	806	11,787	41,850	22,971	213	90	73
November	2.90	0.10	2.05	57	− 3	32.68	597	770	10,641	29,137	18,555	82	60	25
December	8.30	1.20	2.74	63	− 8	34.20	563	791	9,832	40,501	23,063	.....	...	...
Total	.....	.....	.....	...	...	.....	7,785	9,529	127,690	351,834	215,846	1,830	630	618
1876.														
January	5.45	1.40	3.46	60	− 1	29.18	503	719	8,567	32,007	21,010	.....	...	...
February	9.25	1.50	4.03	66	− 7	29.85	561	700	10,230	38,075	17,360	.....	...	...
March	9.95	2.70	6.18	70	6	32.35	653	797	10,780	21,472	6,633	31	11	4
April	13.35	4.50	10.42	74	30	52.14	606	748	10,388	47,392	16,455	173	88	31
May	13.10	10.80	12.03	92	35	64.87	641	826	11,616	28,333	21,714	330	181	98
June	13.10	7.50	9.44	90	45	72.14	668	893	11,585	41,520	22,515	314	101	142
July	10.50	3.20	6.79	93	60	82.33	658	909	9,208	36,540	20,157	280	53	114
August	4.10	2.55	2.72	90	54	77.53	630	990	10,157	33,549	27,008	285	77	88
September	6.60	4.25	5.31	85	40	64.40	605	1,007	9,517	34,580	19,331	254	50	75
October	4.20	2.70	3.26	77	25	49.93	645	1,012	11,343	27,372	27,021	212	69	61
November	3.70	2.80	3.36	67	5	34.00	630	889	11,017	27,330	16,680	88	66	14
December	5.40	1.90	4.76	46	−20	14.98	690	858	11,197	24,257	22,520	.....	...	...
Total	.....	.....	.....	...	...	.....	7,490	10,348	125,605	392,337	239,004	1,976	696	627

* Record of foot-passengers and teams commenced February 14, 1874.

CHAPTER X.

ROCK ISLAND WATER-POWER UNDER MAJOR FLAGLER'S COMMAND, 1871 TO 1876.

Appropriation act of March 3, 1871—History of the work for 1871 contained in annual report—Completion of canal in 1871 prevented by change of plan at request of Moline Company—Notice given that use of water-power must be suspended pending completion of work—October 10, 1871, Moline Company send resolutions protesting against the dimensions and grade of canal and make other complaints—October 16, 1871, Moline Company write a long letter making further protests and complaints—Grade of canal changed—Captain Flagler's report to the Chief of Ordnance on the subject—Reasons for change stated—Indorsement on the report by the Chief of Ordnance—Action taken approved by the Secretary of War—Correspondence with the Moline Company relative to location and construction of bridge over the canal—Correspondence with the Moline Company relative to resuming use of water-power and completion of canal—Captain Flagler's report to Chief of Ordnance giving history of work on the canal and reasons why canal was not completed in 1871—Letter of January 9, 1872, to Chief of Ordnance stating difficulties in regard to division of water-power and collecting rents from the Moline Company as required in the agreements—Plan for settling difficulties recommended—Amount of power estimated—Act of Congress of June 10, 1872, makes appropriations for the water-power—How expended—Plans and location of lower dam—Captain Flagler's plan for transmitting power from lower dam to shops—Submitted to a board of officers and approved—Report containing plans omitted and brief description of same given—Temporary line of transmission for use pending construction of shops—Appropriations for constructing same—Machinery completed—Its erection and use prevented by act of July 12, 1870—Deposits in water-power pool—Portion of same removed in 1874—Work not successful—Excavation of channel through rock recommended—Preamble and resolutions from Moline Company about deposits, January, 1875—April 1, 1875, Moline Company send long letter to Chief of Ordnance—Moline Company propose to build long wing-dam for benefit of water-power at their own expense and have a portion of water-power conveyed to them by United States—General Benét refers letter to Major Flagler for report—Returned with report May 6, 1875—General Benét visits arsenal in May, 1875—Officers of Moline Company visit Washington in February, 1876, and submit their case to Secretary of War and Chief of Ordnance—Major Flagler called to Washington and submits report on water-power—Excavation of channel through rock at the head of pool recommended—Recommendation approved—Indorsements by Chief of Ordnance and Secretary of War, and appropriation for the work asked for—Copy of Major Flagler's report—Congress made no appropriation—Estimate for the work submitted to Congress again in fall of 1876—General Benét's remarks on same in annual report.

The act of Congress approved March 3, 1871, making appropriations for sundry civil purposes for the year ending June 30, 1872, contained the following appropriation for continuing this work:

For Rock Island armory and arsenal, Rock Island, Illinois: continuing the development of water-power, two hundred thousand dollars.

After the death of General Rodman in June, 1871, I was placed in command of the arsenal, and took charge of the work on the water-power. About the 1st of July, the water in the river had so far subsided as to permit the pumping out of the coffers, and work on the canal and dike was resumed.

Lieut. M. L. Poland, Ordnance Department, assisted by Lieut. E. M. Wright, Ordnance Department, was placed in immediate charge of the work. Lieutenant Poland was relieved from duty at this arsenal on the 5th of August, 1871, and Lieutenant Wright remained in immediate charge of the work during the remainder of the season. A full report of nearly everything of interest in connection with this work that transpired during this season will be found in my annual report of principal operations at the arsenal for the year ending June 30, 1872. The work was prosecuted with the utmost vigor till the latter part of December, at which time the gap between the dike and upper wall had been closed,

and the dike and canal so nearly completed that they were ready for use, and the coffers were taken out, the use of the water-power resumed, and water first flowed through the canal on the 30th of December, 1871.

The canal might and would have been entirely completed during that season had not a controversy arisen with the Moline Water-Power Company respecting its required depth. This controversy, its effect on the work, and the action taken respecting it are fully explained in the following correspondence:

ROCK ISLAND ARSENAL, *August 22d*, 1871.

Mr. CHARLES ATKINSON,
President Moline Water-Power Company, Moline, Ills.:

SIR: For the benefit of those desiring power from the United States water-power of this arsenal, I have the honor to communicate to you the following:

In the development of this water-power I expect to complete the canal and stone dam and dike, thus completing the portion of the development required for carrying away the tail-water which has been used by your company, by the first day of December next.

While we are building the remainder of the dike and stone dam it will be necessary that you should use no water. When this part is commenced I will use every effort to complete it as quickly as possible. To that end just sufficient material to complete the dike will be left in the east end of the canal, the nearest end to the point where the material will be required. With all the men and teams upon the work that the limited space will allow, it will require six weeks to build the rest of the dike, say from October 16th to December 1st. By first quarrying the stone and hauling and dumping it in convenient places for reloading, this part of the work can be performed in one month. This extra loading, hauling, and dumping would cost to the Government $2,990.85, and would shorten the time during which your company would be deprived of water about fifteen days, and permit you to continue using it till November 1st. An agreement made and signed by you and J. M. Gould, secretary of your company, and dated September 7th, 1870, requires that this extra expense should be borne by your company. Please inform me if you will do this; and, if so, I will commence preparations for closing the gap according to that plan. If you do not desire to do this, no reply to this letter is necessary, and I will require that the gates in the dam be closed on the 15th of October, and I will then hasten the completion of the dam and dike as rapidly as possible, and will have the canal completed before or at the same time that the dike is completed.

Very respectfully, your obt. servt.,

D. W. FLAGLER,
Capt. Ord., Bvt. Lt. Col. U. S. A., Comdg.

On October 10, 1871, the Moline Water-Power Company sent to me a copy of resolutions passed by its board of directors, as follows:

Special meeting of the directors of the Moline Water-Power Company held at the company's office, Tuesday, October 10th, 1871.

Present, Charles Atkinson, John Deere, J. S. Keator, S. W. Wheelock, and J. W. Atkinson.

On motion of John Deere:

Whereas the agreement to grant the free right of way to the United States for the canal was made upon the express condition that the capacity of the said canal should be sufficient for the purpose of said company; and

Whereas by agreement of September 6th, 1870, it is provided that the natural opening between the dike and wall for the passage of this company's tail-water was not to be closed until the canal should be so far completed that the material to be removed should be only sufficient for the filling up of said opening; and

Whereas it is feared that the too early closing up the natural passage-way for this company's tail-water may be of great permanent damage to its interests: Therefore,

Resolved, That this company, in view of the jeopardy to its interests by too early closing of said natural passage-way, do respectfully, yet earnestly, protest against its being closed up until the capacity of the canal, both as to depth and width, shall have been satisfactorily ascertained, and until the canal shall have been completed and material removed therefrom, as contemplated in the agreement entered into between this company and the United States Government September 6th, 1870.

On motion of S. W. Wheelock,

Resolved, That the president of this company be directed to send a copy of these resolutions to Colonel Flagler, and respectfully request, in the name of the manufacturers, that in view of these facts he takes no action toward shutting off the tail-water until the canal is finished, as provided in said agreement.

CHARLES ATKINSON, *President.*

J. S. KEATOR, *Secy. pro tem.*

MOLINE, ILLS., *October 16th*, 1871.

Col. D. W. FLAGLER,
Rock Island Arsenal:

SIR: I am instructed by the Moline Water-Power Company to say that it is with extreme regret they find this morning that you have seen fit to shut down their gates and stop their wheels, and have commenced proceedings towards closing up the opening left between the end of the wall and the dike for the escape of the company's water pending the complete development of the water-power, in violation of the terms of a special agreement made with the United States Government at Rock Island, as recommended by Gen. A. B. Dyer, Chief of Ordnance, and approved by the Secretary of War, September 7th, 1870.

Attention of this company having been recently called to the fact that the Government was not intending to make the bottom of the canal as low as was agreed between it and General Rodman, a competent engineer has been employed to take the levels and ascertain the grade of the natural bottom of the river from the upper end of the company's tail-race to the lower end of the dam-wall, and from that point to the stake, the top of which is regarded by the Government as the initial point for the bottom of the upper end of the canal; and from this survey and levels it is found that, taking this Government stake as a standard, the bottom of the canal will be left entirely too high to maintain the grade or natural inclination of the bed of the river.

It is found when the mills are running that the top of your initial stake is higher than the surface of the water at a point outside the dike and immediately opposite this stake, and that the bottom or bed of the natural tail-race at the same point is more than 18 inches lower than the top of your stake.

It was never understood or intended by this company in granting the right of way for the canal, that the bottom of the tail-race was at any point, or as a whole, should have any less grade or inclination than the natural bed of the river, because a less inclination or grade would, of necessity, seriously impair the effective force of this company's portion of the power. But, on the other hand, it was distinctly understood and agreed between this company and General Rodman that the grade of the natural bottom of the river should be maintained in the canal and tail-race.

This point we can substantiate by parties who had at the time negotiations with Genl. Rodman for making the entire excavation by contract.

From Lieutenant Shaler it is learned that when this stake was planted, it was done without any previous levels being taken to ascertain true grade, and this (as we think) could only be designed as an approximate grade of where the initial point of true grade might be, and this would seem to be indicated by the remark of another officer, who says that at the time the stake was placed there it was the subject of more or less discussion among the officers as to whether it was low enough or not. In the interview had with you on the subject on Friday last, it was your own admission that with the line as now taken by the Government as the bottom line for the canal, the effective force of the company's portion of the water-power would be considerably diminished in low water.

This company, at the request of the United States Government, granted the right of way through valuable land without pay, but with the express condition that the canal should be of "sufficient capacity;" and they feel that they have good cause for protestation and complaint that any other or different interpretation should now be made whereby their interests are to be very seriously jeopardized or impaired; and do not believe that Congress, were it in session, would for a moment permit such construction of the agreements between this company and the United States Government as would tend in the least to impair the rights or interests of the company.

This company does not admit that the United States Government has the right under the terms of any existing contract or agreement to enter upon and shut down its gates at will, except under special arrangements or as a military necessity; and thinks that now it has special reason to complain that the Government is acting in violation of the letter and spirit of the special agreement made and approved by the Secretary of War September 7, 1870, a copy of which is now in your office.

From long familiarity with the workings and operations of this water-power in low water, this company knows that if the present determination of the Government is adhered to, viz, to leave and make the bottom of the tail-race where now indicated, it will work great pecuniary and permanent damage to its "one-fourth part" by diminishing its head, and thus reducing its quantum of power in low water; and in view of the fact (and in no spirit of faction or of opposition to the Government) that so much remains to be done to get the bottom down to necessary grade, and that it is now so late as to render it altogether improbable that the canal can be finished this season, they feel compelled to insist that the present natural tail-race between the dike and the wall shall not now be closed.

In view of these circumstances and facts herewith presented, I am instructed by this company to enter this as its formal protest against the closing up of the natural outlet or tail-race for the water this company has a right to use, and request that it be not

closed until the letter and spirit of contracts are complied with, and until it shall have opportunity to ask the interference of Congress in protection of its rights; and to say further, that if because of superior force or for any other reason this company is wrongfully deprived of its right to continued use of its entire portion of the power, it will claim and endeavor to hold the Government liable for all the damage it may sustain thereby. I am also further directed to request that the matter be referred to the Secretary of War, with a copy of this letter.

With great respect, I am your obdt. servt.,

CHARLES ATKINSON,
President Moline Water-Power Co.

On October 19, 1871, I notified the Moline Water-Power Company that I had had surveys made of the bed of the river above the canal, and had determined to lower the bottom of the canal below the grade established by General Rodman, as indicated by the initial stake; that the grade would be such as to give a continual fall from the head of the river, from below the foot of the stone dam to the mouth of the canal.

(NOTE.—The maps and drawings which accompany this letter do not accompany this history. The initial stake A′ referred to is shown on Plate XI.)

On the 24th of October, 1871, I wrote to the Chief of Ordnance as follows:

ROCK ISLAND ARSENAL,
October 24th, 1871.

Brig. Genl. A. B. DYER,
Chief of Ordnance, Washington, D. C.:

SIR: I have the honor to transmit herewith a copy of a letter from Mr. Charles Atkinson, president of the Moline Water-Power Company, received by me on the 17th inst., a copy of my reply dated the 18th inst., and a copy of a letter to Mr. Atkinson, written for me by Lieutenant Butler on the receipt of Mr. Atkinson's letter.

Mr. Atkinson desires that his letter should be transmitted to the Secretary of War.

As I have not stopped work, (on the development of the water-power,) as required by the Moline Water-Power Company, I deem it just to myself to explain to you and to the Secretary of War my reasons for continuing the work.

That the case may not be misunderstood, I will ask you to bear in mind while reading this paper that deepening the canal can have no effect to increase the Moline Water-Power Company's portion of the water-power, except during the time of very low water. (This is shown in a drawing marked "A," inclosed herewith.) Had the time for completing the canal occurred at an ordinary stage of water in the river, I do not think the point which the company make would have arisen. Just now the river is very low, lower, I believe, than at any time during the last seven years.

An inspection of Drawing A will show that in such extreme low water as exists now digging out the tail-race below the natural bed of the river would continue to increase the head of water at the stone dam till the whole tail-race should be brought down to the level of the water at the Rock Island wagon-bridge. Estimates will show, however, that the interest on the cost of such digging out would be many times greater than the average annual increase of value of the water-power due to such increased head.

Nevertheless, the Moline Water Power Company will get the Government to dig out a portion or all of this if they can.

The agreement between the Secretary of War and the Moline Water-Power Company, dated April 8th, 1869, says, "that the canal shall be of sufficient capacity for the purposes named," that is, to carry off the company's tail-water.

However much this may mean, it cannot intend to insure to the Moline Water-Power Company a tail-race of greater capacity than the company would have had by the other mode of development; that is, the mode of development that would have been used had the canal not been dug, which was to continue the water-power dam nearly parallel to the south bank of the river, and allow to the company for a tail-race the space between the south bank and the dam. (See the line marked *o′ o′* on Plate XI.)

Mr. Atkinson stated to you, while in my office abont a week ago, that he would have claimed for a tail-race, under that development, one-fourth of the width of the river. If this one-fourth part of the river is all the Moline Water-Power Company would have claimed under that development, I suppose it is at least as much as the Government could in justice have allowed to them, and that, therefore, the Moline Water-Power Company should now claim no better tail-race with the canal development than one-fourth the river bottom would have given them.

An inspection of the inclosed drawing, marked B, will show you how little change the canal development made in the position of that portion of the tail-race which lies above the canal, and will enable you to understand better what follows.

The circumstances attending the location of the initial stake A' * by General Rodman, referred to in Mr. Atkinson's letter, as near as I can ascertain them from the officers stationed here at the time, are as follows:

In July, 1870, after the coffer, shown by dotted lines D on Drawing B, had been put in and the water pumped out of the inclosed space, General Rodman, assisted by Captain Schaff and Lieutenant Shaler, planted the stake. The water having just been pumped out, water was still standing in low places, and indicated plainly the position of the bed of the river.

After an examination of the river-bed and planting stakes at several other places, the general fixed upon the position of the stake and had it driven down. Its top was below the surface of the mud in the bottom of the river at that point.

No levels with an instrument were taken at that time, and it does not seem that instruments could have determined the bed of the river as well as it was shown by the mud and water standing in the low places. The general then ordered that this stake (called stake "A") should be taken as the initial stake, and (after a subsequent survey) that the bottom of the canal should fall nine inches between stake A and the mouth of the canal. This subsequent survey, made a few days afterward, determined the natural fall of the surface of the water in the river between the stone dam and the mouth of the canal to be nine inches, (the river at the time being so high that water backed up from the lower end of the island.) Mr. Atkinson says "that at the time the stake was planted there, it was a subject of more or less discussion among the officers as to whether it was low enough or not."

I can learn of no such discussion, except the following: Before the stake was planted, as described above, Lieutenant Shaler had thought to place it at the bottom of a pool near the foot of the dam-wall. General Rodman told him that was too low, and after he (Gen. R.) had planted the stake, as described, he said, "That is low enough."

After that the work was commenced, and has always been carried on upon the plan thus determined upon by General Rodman.

On the day of my arrival at this post I inspected the canal and water-power. Captain Poland had been in charge of the work on the canal last year, under General Rodman, and he and Captain Comly were with me. They explained to me the manner in which the position of the stake A had been fixed upon.

Seeing its importance, I made particular inquiries about it, and after hearing their explanation I felt sure that it was correctly established, and did not think it necessary to make surveys or further investigations.

I never heard, until now, that any officer at this arsenal had ever discussed, or even thought of, deepening the canal below the grade thus determined by General Rodman, and they tell me they have never done so.

Moreover, I had always supposed that the matter had been discussed between General Rodman and the Moline Water-Power Company, and had been agreed upon between them.

I have made this explanation to show you that the grade, as established by stake A, *was* established by General Rodman; that it was done after careful consideration; and that, in his (Gen. R.'s) opinion, it was the proper grade to give to the bottom of the canal.

Upon this plan the canal has been dug. The work has been open to the inspection of the Moline Water-Power Company during the whole of this season and last season. It has been visited by members of the company frequently, and I supposed until quite lately, that they understood the whole matter, and that there was, and could be, no question about it.

Lieutenant Wright did once point out stake A to one member of the company, Mr. Charles Deere, and explained to him its significance. No complaint against the Government plans, or request that they might be changed, ever came to me until so late in the season that a material change in such plan would cause a year's delay in the work, and much loss to the Government.

I inclose herewith my letter (marked "L") to the Moline Water-Power Company, notifying them of the time when the gates must be closed.

This letter is dated August 22d, 1871. I have never received any reply to it; but some time after it was written, I think about two weeks, the company called upon me, and raised some questions about the depth and width of the canal.

I explained to them my understanding of the matter, as explained in this letter.

I did not think then that the canal ought to be deepened, and told them so.

That was the first complaint made to me about the work. I then, at once, commenced some surveys to determine satisfactorily whether there was any justice in the

* This stake is shown on Plate XI in the east end of the canal.

complaint. These surveys were in progress when you arrived at this post, and have been completed since you left.

Such surveys as had been made previous to shutting the water out of the tail-race indicated that the bottom of the canal was low enough. This I explained to you while you were at this arsenal.

The gates were closed Saturday night, (14th inst.,) and on Monday the bed of the river was nearly dry. I then completed the surveys.

Map marked "B" shows the bed of the tail-race. Just below the lower end of the stone dam I have taken a section (marked "*a*") across the tail-race. As this section would have extended entirely across the tail-race, in the no-canal mode of development, it is just to take it as the natural bed of the tail-race, and as an initial point.

Taking it, then, as the initial point, it will be seen that the bottom of the river in this section is, say six-tenths of a foot higher than the top of the stake as planted by General Rodman. Farther down I have taken another section, (marked "*b*.") This section would also have extended across the tail-race in the no-canal mode of development. The bottom of section B is lower than the top of stake A', say seven-tenths of a foot. The fall in the tail-race, from the stone dam to the canal, would therefore be seven-tenths of a foot less than by the no-canal mode of development. I am not willing to admit that the Government is under any obligations to lower the canal on this account; but to prevent controversy, and as there was no time to refer Mr. Atkinson's letter to the Secretary of War, I have determined to lower the canal, as shown in my letter, marked "P," to Mr. Atkinson.

I will lower the upper end of the canal one foot and the lower end one foot and three inches below the grade established by General Rodman. This makes the fall in the tail-race a little more than it would have been in the natural tail-race obtained by the no-canal mode of development.

I do not know that this will be satisfactory to the Moline Water-Power Company, and I presume it will not be, for an object of Mr. Atkinson's protest seems to have been to prevent the completion of the canal this fall, and this change of grade will not prevent it.

The gates are still closed, the position of the coffers have been changed, and I am now completing the unfinished portions of the stone dam and embankment, thus closing the gap between the company's tail-race and the river, and at the same time am pushing the work on the canal, so that it shall be completed before or at the same time that the dam and dike are, as required by contract. If the whole work cannot be completed this season, I expect to complete the canal, and raise the dike high enough to make the tail-race good, and then open the gates again, leaving the dike to be finished next season.

I have been compelled to act in this matter without waiting till it could be referred to you for a decision. So much time would have been lost by such a reference that the work could not have been completed this season, and the Moline Water-Power Company would have attained their object, even had you decided against them.

The importance of completing the work this season I explained verbally to you while you were here.

If it is not completed, high water will prevent work next year till about the middle of June; then the expense of pumping out water, repairing coffers, getting men, teams, and tools ready for work would be considerable, and before work could be fairly commenced the money appropriated for this work would revert to the Treasury, (on the 1st of July,) and the work must be left unfinished until new appropriations could be obtained from Congress.

In the mean time the work is secure against damage from freshets, and the Moline Water-Power Company continues to get the use of the whole water-power free of rent.

Perhaps the Moline Water-Power Company have not fully considered the effect of a compliance with their demands, as set forth in their protest; but they certainly have postponed their protest till so late that a compliance therewith, or even a reference of the same to the Secretary of War, would cause great loss to the Government.

Should the Secretary of War decide to grant to the Moline Water-Power Company what they demand, I respectfully request that you will telegraph me to that effect.

I am now filling up the gap between the wall and dike, and granting what they ask would necessitate clearing out this gap again at considerable loss to the Government.

I am, sir, very respectfully, your obedient servant,

D. W. FLAGLER,
Capt. of Ordnance, Bvt. Lt. Col., U. S. A., Comdg.

On the 30th of October, 1871, the Chief of Ordnance telegraphed to me to continue the development of the water-power without regard to the protest of the Moline Water-Power Company.

In the letter dated November 3, 1871, the Chief of Ordnance informed

me that my letter of October 24 had been referred to the Secretary of War with the following indorsement, and that the recommendations contained in said indorsement had been approved by the Secretary:

[Indorsement of Chief of Ordnance.]

ORDNANCE OFFICE, *October* 31, 1871.

Respectfully submitted to the Secretary of War, whose attention is invited to the within report of Captain Flagler, the commanding officer of Rock Island arsenal, in which this bureau concurs, and recommends the approval of the dimensions of the canal, or tail-race, for the Moline Water-Power Company, as it has and may be established and fixed by the commanding officer of the Rock Island arsenal, and also his decision to push at once to completion, if possible, the tail-race this fall.

Under existing agreements, the United States should, I think, provide a tail-race to carry off that proportion of water which this company is entitled to use, viz, one-fourth of the whole water-power.

This was all that was contemplated by the original river-bed tail-race, and the company have no right to claim that the United States shall, in the present tail-race, prepare an escape for a greater quantity of water.

I can see no objection to permitting the water-power company to enlarge the canal at their own expense, to allow the water which it may rent from the United States to escape at all stages of the river.

If the interest on the capital required to enlarge the canal for the escape of rented water should exceed the amount of rent received for that water, it is evident that the United States should not enlarge the canal for the purpose of renting power.

In this view it will not be deemed expedient nor economical to rent any power whatever to the Moline Water-Power Company.

Captain Flagler is of the opinion that the tail-race which he is building will allow a greater escape of water than the river-bed tail-race, which was first contemplated and approved by the Moline Water-Power Company, and surely that company ought not to claim more tail-race than that method would have given them.

In my opinion, everything has been granted to the Moline Water-Power Company that they can justly claim.

A. B. DYER,
Chief of Ordnance.

The papers have been returned to this office indorsed with the approval of the Secretary of War, and the foregoing is now communicated to you for your information, action, and guidance in the matter of the tail-race for the Moline Water-Power Company.

Respectfully, your obt. servant,

A. B. DYER,
Chief of Ordnance, U. S. A.

On November 20, 1871, J. M. Gould, secretary of the Moline Water-Power Company, wrote to me inclosing a sketch showing the position selected by the company for the proposed bridge over the canal.

On November 23, 1871, Charles Atkinson, president of the Moline Water-Power Company, wrote to me as follows:

CONCORD, N. H., *November* 23, 1871.

To Col. D. W. FLAGLER,
Rock Island, Ills.:

SIR: I am just advised that you propose to put a pier into the canal, three feet wide, on which to rest the middle of the bridge.

I have always been afraid (and am still) that 150 foot wide will be entirely too little for the escape of our tail-water when the whole power is fully developed, and as this pier will considerably diminish the capacity, allow me to suggest whether, say, three iron columns of oblong shape, properly braced up and down, would not fully answer the purpose of the piers, and be of less cost, and be taking up very little room.

If this plan would answer, water in the canal would not specially be in the way of putting them in if a level seat was prepared and proper holes drilled for fastening.

Very respectfully, your obt. svt.,

CHAS. ATKINSON,
Pres't. M. W. P. Co.

should be fixed upon and agreed to by the United States and the Moline Water-Power Company before the surveys are commenced. As there will probably be difficulties in the way of such an agreement, I would suggest, in case an agreement cannot be arrived at, that then the United States and the Moline Water-Power Company employ the most competent water-engineer that can be found, one competent to decide legal points in the case; that he examine the water-power, all the papers and surveys relating thereto, and that his services be used in arranging an agreement.

This agreement should state what is, and fix definitely, the fourth part of the water-power. It seems to me that there are but two methods of doing this. As stated once before in this letter, the water-power, and consequently a fourth part of the same, is a variable quantity. The surveys made must determine the amount of water available for the water-power at every stage of water in the river. Then the agreement must either fix the amount of water that the Moline Water-Power Company shall have at every stage of water, or else an average of the water-power must be fixed upon, and the average amount must be given to the Moline Water-Power Company at all stages of water.

In either case the agreement should certainly state the amount of water in square inches of cross-section. So much time must elapse before such an agreement can be made, that it is not necessary now to decide upon either method, and the same surveys would give the necessary information for both. I will state, however, that it is my opinion now that the latter method is preferable. It will avoid much serious annoyance in making up and settling accounts against the Moline Water-Power Company for rents, and would remove, in a measure, causes of complaint by the Moline Water-Power Company respecting the condition of the pool and of the water-channel leading into it. I should also think it must be much more satisfactory to the Moline Water-Power Company. The principal objection to the latter method is that the Moline Water-Power Company would get more than its share of the power at extreme low water, because at such times the power is least, and this might deprive this arsenal of its full three-fourths of the power when it most needed it. This objection can be avoided by a clause giving to this arsenal always its full three-fourths of what was the Moline water-power and all of the Sears water-power when it requires the use of it. When all the power is being used and the amount of water used by every wheel has been agreed upon, there can be no difficulty in making the division of power.

I respectfully ask your consideration of the subjects discussed in this letter, and if any plan is adopted for the settlement of the questions involved, that action in the matter be taken before next spring. If the plan that I have suggested is approved, I will lay it before the Moline Water-Power Company, and endeavor to get their co-operation in carrying it out. I believe, however, that the first thing necessary to any settlement is that a decision respecting the ownership of the Sears water-power should be arrived at, and I again urge that that matter may be so arranged as to insure to this arsenal the full right to use all of the Sears water-power whenever and wherever the wants of the arsenal require it.

The whole water-power is the greatest number of foot-pounds that can be obtained by multiplying together the weight of water used and the head or number of feet through which the water falls at the dam; due regard being given to economy in not reducing the head too much. If the whole water-power is used, the water in the pool will be lower and the head less than when only a part of the water is used, and because the water in the pool is lower, a greater amount of water will be flowing into the pool.

The most advantageous head of water must therefore be determined, and that head be maintained (by partially opening unused gates in the dam) while the surveys are being made.

If we go back to the time when Sears owned his water-power and the Moline Company owned its power, it seems clear that Sears had a right to use all of his power, and that, when he did so use it, the Moline Water-Power Company did not and could not claim a one-fourth part of it. Now that the United States has bought Sears's power, and has acquired the other power also, it seems even more clear that the United States may use the whole of the Sears power, and that the Moline Water-Power Company has no claim upon any part of it. I can find nothing in the original agreement between the United States and the Moline Water-Power Company, or in the proceedings or reports of the commissioners, from which the agreement is made, upon which the Moline Water-Power Company can base a claim to one-fourth part of the Sears power. On the contrary, the wording of the paragraph of the agreement which I have quoted seems fairly to exclude any such claim. But when Sears did not use his power, and the water which he might have used was deflected into the pool of the Moline Water-Power Company, it seems that the Moline Water-Power Company had a right to all the benefit of that water, and that Sears had no claim upon that company for the use of his water. I suppose it is under this plea that the Moline Water-Power Company now claims a fourth part of the whole water-power, including the Sears or Benham's Island

power, but I do not think the claim a good one. The agreement gives to that company only a fourth part of what was the Moline water-power.

The United States now owns both the Sears (or Benham's Island) water-power and what was the Moline water-power. In the ownership of the latter is included the pool and all the river between Rock Island and the dam and dike along the south shore.

If the Government chooses, I think it has a right now to deflect the water of the Sears power from Benham's Island into its own pool on the south side of Rock Island, and to convey the water over its own premises to its own dam, and to use it there.

If this is a just and legal right, I believe it is very important to the United States that it should be maintained, because the whole of the Sears water-power, added to the Government's three-fourths of the other, (the Moline power,) will not exceed the future possible wants of this arsenal when worked to its full capacity.

It is certainly very important that the United States should maintain its right to use all the power to which it is legally entitled, whenever a pressure of work shall require it.

It is certainly clear that the United States has a right to use the Sears power at the upper or east end of the island without any diminution by a fourth part. If it has the right to convey all of the same water to its water-power dam south of the island and to use it there, that right ought to be maintained.

When this arsenal does not require the use of its water-power, holding this one-fourth part of the Sears power for rent to the Moline Water-Power Company is not so important, nor do I think the right to it so clear.

If granting this right would facilitate a settlement of the questions involved, I would recommend that it be granted.

I add some calculations on this subject. If the Sears power is one-third of the whole water-power, one-fourth part of the same, which is the amount of power in question, would be one-twelfth part of the whole water-power. I estimate the measurement of this one-twelfth to be about 2,100, say 2,000 square inches of cross-section at the water-power dam.

The rental of this at the small nominal price fixed upon in the agreement would be $1,000 per annum.

The amount of power to be rented for this sum is fully 500 horse-power, (actual.) If this arsenal should require this power and were forced to procure it by steam, it would not cost less than $12,000 per annum, and the loss of time required for preparing the power might cost still more.

In the act of Congress making appropriations for sundry civil purposes for the year ending June 30, 1873, approved June 10, 1872, the following appropriation for prosecuting work on the water-power was made:

Rock Island armory and arsenal, Rock Island, Illinois.

For completing development of the water-power, one hundred and ten thousand dollars.

This money was expended in completing the water-power canal and in constructing the lower dam-wall, (marked "*k k*" on the map on Plate XI.) A full history of nearly all that is interesting in connection with this work is given in the reports of the principal operations at the Rock Island arsenal for the years ending June 30, 1873, 1874, and 1875, copied in Chapter VIII, Appendices B, C, and D, of this book. A cross-section and elevation of this wall are shown in Plate XII.* The stone dike which connects the end of the wall *k* with the Illinois shore is the same in construction as the dike *q d*. The reasons for selecting the line *k k* (see map on Plate XI) for the lower dam were as follows:

1st. It was necessary to select a line longer than the shortest line across the channel in order to gain room for the requisite number of water-wheels.

2d. The line selected gave the greatest strength to resist the action of ice moving down the channel. There is in the island shore, just above the point *a*, an old quarry. This quarry, in connection with the sharp bend in the channel and the strong stone dike and end of the wall at *k*,

* The cross-section and elevation of this wall were made to conform as nearly as possible with some plans that General Rodman had made for it.

should stop or break up any heavy mass of ice moving down against the wall.

3d. Making the line *k k* parallel to *w x* was most advantageous for solving the difficult question of the transmission of the power developed to the shops.

It was expected that a portion of the appropriation for the water-power for the year ending June 30, 1873, could be used in making preparations for and in putting in water-wheels. But, as explained in my annual report for that year, the change in the grade of the bottom of the canal and the consequent delay in finishing the canal, and the greatly increased cost of the work, so far delayed the completion of the water-power that the wheels could not be put in, and it required all of the water-power appropriation for completing the canal, the lower dam, and dikes. There was, therefore, nothing done in that year toward utilizing the water-power for the shops, and the matter was postponed till the following year.

TRANSMISSION OF POWER.

In the winter of 1873 and 1874, I prepared complete detailed plans for transmitting the power to be developed at the lower dam *k k* to the armory and arsenal shops. These plans were sent to the Chief of Ordnance on the 8th of April, 1874, and a board of officers, consisting of the following members: Col. P. V. Hagner, Ordnance Department, Lieut. Col. T. T. S. Laidley, Ordnance Department, and Major J. G. Benton, Ordnance Department, was appointed by the Chief of Ordnance to visit the arsenal and examine the plans. The board was in session at the arsenal from the 24th to the 29th of April, and after a careful examination of the plans recommended their adoption, which was approved by the Chief of Ordnance.

These plans give complete details, calculations of strength of parts, loss of power by friction, bills of materials required, and full working drawings.

The report containing the plans is very long, and as it is more professional than historical in its nature, and is to be made a separate publication, it is omitted.

Only a brief general statement of the plans is necessary to explain the history of some work that has already been done in constructing the machinery for transmission.

Two lines of shafting are to be laid on the dam *k k*, each to be driven by twenty turbine water-wheels of 65 inches diameter each. From the shore end P of these shafts four lines of wire-rope transmission are to be run, two from one shaft to *w*, and two from the other shaft to w^1. These lines are calculated to transmit 500 horse-power each; 2,000 horse-power in all.

The two lines which run to *w* are to drive a shaft, *w x*, laid under the row of arsenal-shops, and the two lines to w^1 are to drive the shaft w^1 x^1 laid under the armory row of shops. These shafts are to be in a masonry tunnel underground (between the shops) and in the shops, to be 2 feet above the basement-floor, and 6 feet from the front basement-walls of the shops, where there are no doors, and where they will be out of the way. From them power is to be communicated at pleasure to the main lines of shop shafting by belting in the ordinary manner.

These shafts could not be put in conveniently or economically until all the shops were completed. It was found that a temporary line of transmission of sufficient capacity for the present limited wants of the arsenal would pay for itself in furnishing power for use during the con-

struction of the remainder of the shops. A more important argument in favor of this temporary line was that we have insufficient knowledge of and experience in wire-rope transmission on so large a scale as is required for the permanent lines of transmission, viz, 500 horse-power in each rope. By building this temporary line for wire-rope transmission and using it a few years, we would gain the required knowledge and experience, so that when the permanent lines were put up they could be erected in the very best manner, or if experience should prove it wise, the wire-rope transmission could be abandoned altogether, and lines of shafting, more expensive both in cost of plant and waste of power, could be substituted between P and $w\,w^1$. Therefore, the plans embraced the construction and erection at once of this temporary line of wire-rope transmission of sufficient capacity to carry 300 horse-power. This line is to run from P to T, and, turning the corner at that point, to run along the south line of shops to such of the arsenal-shops as are now in use and will be used pending the construction of the other shops. All, or mainly all, of the machinery for this line was so planned that it could be transferred to the permanent lines when they should be erected.

The machinery for this temporary line has been constructed and is now ready for use. It could not be put up and used this year, because an act of Congress respecting appropriations has prevented it, as will be shown in giving a history of the work.

In the act of Congress making appropriations for sundry civil purposes for the year ending June 30, 1874, there was the following item for this work:

> For machinery for transmitting power from the water-power to shops, eighteen thousand dollars.

This was partly expended in building foundations of pulley-house at P, the construction of wing-walls for the protection of the same from the river, and in purchase of wire rope and materials; but so much time was consumed in perfecting the plans, and it was so late in the year, that all of the appropriation could not be used advantageously. About $11,000 of the appropriation was used.

In the act making appropriations for sundry civil purposes for the year ending June 30, 1876, there is the following item:

> For furnishing power to the shops already built, eighteen thousand five hundred dollars.

With this appropriation the necessary machinery was manufactured for developing and transmitting about 275 horse-power, by the temporary line of transmission described above, as far as shop C. (See map on Plate XI.) This includes four 65-inch turbine water-wheels, four wrought-iron penstocks, with timber floors; also 98 feet of 9-inch wrought-iron shafting, with pillar-blocks and other machinery for taking off the power and bringing it to the shore, the framing and preparing for erection a pulley-house on the shore and machinery-house on the dam, the erection of five towers to carry the line of wire ropes, and the manufacture of the pulleys and other machinery to go on the towers. All this machinery and the fixtures were manufactured in the arsenal-shops, and at a cost much below the prices at which they could be purchased. The machinery was completed during the year for which the appropriation was available, and there was enough of the appropriation left for putting in the water-wheels and for putting up the machinery. The water-wheels and penstocks could be put in only during low water, and high water lasted until the close of the fiscal year. The act of

Congress, approved July 12, 1870, requiring unexpended portions of appropriations to be covered into the Treasury at the close of the fiscal year, limited the time in which the work might be done to June 30, 1876. The stage of water in the river would only permit the work to be done after that time. This state of affairs was foreseen, and every effort that I could put forth was made to procure authority to put in the machinery during the low water, which would occur in the months of September and October following, but without success. The machinery and water-power is therefore lying idle, and the United States incurring the expense of steam-power until another appropriation can be obtained for putting in the machinery.

A more full account of the manufacture of the machinery, and the bad effect of the law referred to above, in this particular case, is given in my report of principal operations at this arsenal for the fiscal year ending June 30, 1876. (See Chapter VIII, Appendix E.)

The obstruction to the successful prosecution of building operations like those at this arsenal, produced by the act of Congress approved July 12, 1870, and the trouble and loss to the United States which it causes, have been repeatedly set forth in annual reports from 1872 to 1876, (see Appendices to Chapter VIII,) and in special reports and letters on the subject, and efforts to obtain relief from its operation have been made by the Chief of Ordnance, but without success. Copies of some of these papers were collected and the subject explained in giving a history of the principal building operations in Chapter VIII.

DEPOSITS IN THE WATER-POWER POOL.

In my annual report for the year ending June 30, 1873, (Appendix B, Chapter VIII,) a report was made respecting the deposits which were forming in the water-power pool.

In June, 1874, an effort was made to remove a portion of the deposits and to benefit the water-power thereby. Authority was obtained from the Chief of Ordnance, Brig. Gen. S. V. Benét, to use on this work some unexpended appropriations made in 1870, for carrying out a contract with the Moline Water-Power Company, in which was a clause requiring deposits to be removed.

A dredge and scows were hired at $75 per day, and employed 20¼ days on the work, but with unsatisfactory success. The Moline Water-Power Company had complained that the old coffer-dam just east of the bridge to Moline had not been properly cleaned out, and that the remaining *débris* was damming the water back. The dredge was employed some days at this point, but only a small amount of material was found. After that work was continued in trying to open a channel through the deposits from a point opposite the head of the wing-dam down nearly along a channel marked "*m m*" on Map XI. This work was not very successful. Generally, the depth of the deposit was so little that only a part of a scoop-full or none at all could be taken out. The mud silt was soft and fluid, and could be held on the scows only by damming the sides of the scows with hay and coarse manure. I could not ascertain from the officer in charge of the work the amount of material taken out, and it was not easy to determine. I believe about 2,300 yards were taken out. As will be explained in papers to follow on this subject, the deposits lie all the way across the head of the pool, and under them the bed of the river is an uneven surface of rock. There is not much use in dredging out the low places in the rock, and on the high places the deposit is so shallow and the rock-bed is so uneven that suc-

cessful dredging is generally impracticable. If the deposits could be taken out clean over all the upper part of the pool, then the water could find its way, even at extreme low water, along the low places in the rock; but this work would be so difficult and costly as to make it impracticable.

I believe the solution of this troublesome question to be the removal of enough rock to make a thoroughly good channel, (marked "*m m*" on Map XI,) which can always be kept open economically and effectively by dredging or washing.

The Moline Water-Power Company have advocated the prolongation of the wing-dam about 2½ miles up the river to the point A. (See dotted lines on Map XI.)

This matter is fully discussed, and the action that has been taken respecting it is given in the following correspondence:

MOLINE, *January* 15, 1875.

Colonel D. W. FLAGLER,
Rock Island Arsenal:

SIR: Inclosed please find a copy of preamble and resolutions as passed by our board of water-power directors. I am sure every one is in full sympathy with all that pertains to the interests of the arsenal, yet the interests of the company are so connected with the improvement and maintenance of the water-power, they can't see any way out into daylight but in the way indicated by their action as herewith expressed. I hope you may be able to see some way by which so much dredging can be done next spring as should secure the object sought.

Yours, very truly,

CHARLES ATKINSON,
President Moline Water-Power Co.

At a meeting of the directors of the Moline Water-Power Company, held at its office, January 14, 1875, the following preamble and resolutions were adopted:

Whereas, under special agreement and contract entered into between the Moline Water-Power Company and the United States Government, at Washington, D. C., April 8, 1869, it was, among other things, expressly agreed and stipulated that the United States Government should, as early that season as the stage of water would permit, remove the deposits from the pool; and

Whereas Government has not only not fulfilled its agreement, having removed only part of said deposit, but has also allowed large accumulations of deposit, notwithstanding existing agreements that the Government is to maintain the water-power, and the company to have free use in perpetuity of one-fourth of the entire water-power developed; and

Whereas the allowing of the water to shut away from, and out of the pool, so that the wheels of the company or its lessees are not properly supplied, is damaging to the interests of the company, subversive of the spirit and design of the company in transferring its property to the Government, and in violation of express agreement; and

Whereas this company has at all times in good faith carried out its pledges to the Government, so the Government in like good faith ought to carry out its pledges to the company; and

Whereas these deposits which so materially injure the water-power can be removed at comparatively small cost and thus secure temporary benefit: Therefore, on motion,

It is hereby resolved, That unless some satisfactory assurances can be obtained by this company that the deposits will be so removed as to secure a reasonable supply before the next season of low water, this company does not perceive any other way or remedy to protect its interests but by direct appeal to Congress at the present session, asking that special appropriation of money be made to the end that the contract of April 8, 1869, be carried out.

On motion,

Resolved, That a copy of the above be sent to Colonel D. W. Flagler, commandant at United States arsenal on Rock Island, with request to favor this company with his views thereon at an early day.

No written reply was sent to this letter, but the matter was discussed with the water-power company at various times during the winter and

spring, and two members of the company visited Washington in the spring to confer with the Chief of Ordnance on the subject. After this visit, the following correspondence occurred:

OFFICE OF THE MOLINE WATER-POWER COMPANY,
Moline, Illinois, April 1st, 1875.

To General STEPHEN V. BENÉT,
Chief of Ordnance, Washington, D. C.:

SIR: Feeling that you may not be familiar with the circumstances attending the transfer of water-power and contracts between the Moline Water-Power Company and the United States, permit me to present for your consideration a brief statement of the general facts, and of the claims of the company.

During the season of 1866, prior to the Rock Island Commission coming here, General Rodman had made known to the company the desire of Government to possess itself of the whole water-power, and when the Commission came several interviews were had with myself, acting for the company, and a very full discussion of the whole subject-matter took place, and at an adjourned meeting of the Commission, held at Washington, the contract and agreement was consummated, as it will appear by the report of the said Commission submitted to the Secretary of War, February 14th, 1867; but the contract was not finally signed until August 16th, 1867.

It was understood by the company that the development of the water-power meant, and was to be, such a development as would give the entire power of all the water that could be made to pass through that branch or portion of the river lying between the island of Rock Island and the Moline shore, and requiring, in order to maintain a suitable head of water in the pool, an extended wing-dam of proper height, and the entire removal of deposits then in the pool. It is the failure of the United States to perform its agreements that makes it a necessity for this company to call your attention to the matter at this time; and I would also say, in this connection, that this company have always felt that the assumption by the Government that it *must* transfer its water-power possessions to the United States was arbitary and coercive, and to which it would not have willingly yielded but for assurances of prompt and fair fulfillment of all promises, agreements, contracts, understandings, and obligations.

The failure in regard to wing-dam was that instead of making it only of proper height to subserve its purpose in low water, and extending it as far *up* stream as the appropriation would admit, a very large portion of the money (probably not less than two-thirds) was used in increasing the height and width of the wing-dam at its lower end, entirely above any elevation of the least value whatever to the water-power on the Moline side of the island; and this use of the money was made against the repeated protests of the president of the Moline Water-Power Company, that it was in direct violation of the whole understanding and agreement as to the way in which this $40,000 should be expended.

It is well known that one of the principal inducements at the time of making the arrangements with the Government was the extension of the wing-dam far up the river, so as to maintain head in low water. From one and a half to three miles in length was talked about, and never less than the former distance. The commanding officer at the time was arbitrary in his decision as to how this money should be expended, and the company feeling itself to be without remedy, were obliged to submit. Subsequent to suspension of work on wing-dam, General Rodman spoke of excavating a channel into the pool from the main channel of the river, as a substitute for the further extension of the wing-dam, (except so far as the excavated material would go.) To this plan ready assent was given by the company, provided deposits were kept out of the excavated channel; but even this plan has not been carried out, or any move made in that direction; and as to removal of original deposits, very little, if any, of the $40,000 was used for this purpose. Nothing was done that season in removing deposits at the mouth of the pool. A second leading reason and inducement the company had in making the contract with the Government was, the removal of these deposits that had accumulated in the pool. This matter was fully discussed between the Commission, General Rodman, and the president of the water-power company, and it was distinctly understood and agreed that Government were not only to remove the then present deposits of mud and sand from the pool, but were to keep it clear thereafter, it being agreed that the words "to maintain the power" carried with it the obligation to keep the pools open so that wheels could be fully supplied.

It will be noticed that section 6 of Commissioners' report provides that neither party shall have the right to obstruct the pool to the detriment of the water-power, yet the government has not only not performed its agreements in removal of deposits, but has actually placed obstructions across the pool and suffered the same to remain, (and which are not yet removed,) and thus help increase obstruction to the manifest detriment of the water-power. In further consideration of this subject of removal of deposits, I call your attention to a special contract between this company and Govern-

ment, made April 8, 1869, which recognizes and refers in section 3 to the existing agreement to remove deposits in the pool, and makes special agreement to remove them that season as soon as the stage of water will permit, and yet it was not done that season, and has remained unaccomplished to this time, although Congress has made appropriation of money to carry out these existing contracts. The company therefore feel justified in complaining of the bad faith of Government; that having received transfer and taken possession of its property, it should continue to withhold fulfillment of its obligations, in consequence of which manufacturers in Moline depending on water-power have, during several of the seasons of low water, been obliged to almost entirely suspend operations for want of power because water could not get into the pond; and for the same reason they have been obliged to entirely stop for nearly the whole of the past winter, thus, as is seen, materially damaging the interests of this company and placing the water-power in bad credit.

The particular causes of complaint are that Government has not constructed the wing-dam as was understood and agreed.

It has not excavated a channel into the pond as was proposed as a substitute.

It has not removed the deposits existing in the pool as was agreed, and for which appropriations have been made.

It has failed to take away the obstruction that it placed across the pool to subserve its own interests when erecting the dam-wall.

It has failed and neglected to remove deposits that have accumulated since the execution of the original contract, and which are yearly increasing to an alarming extent, and which, if not provided against, must and will in the nature of things render the entire power worthless in the common low stages of water in the river.

In assurance that the company have not willingly let this matter lie still and go by default, allow me to say that attention of the commanding officers on Rock Island has been frequently called to the matter, and the company has more than once or twice determined to ask special aid of Congress, but at the solicitation of friends of the arsenal have deferred so asking for the time, in order not to interfere with or jeopardize the getting of appropriations for the arsenal, hoping, and being made to believe, its time would come by and by, which seems now afar off.

It has been suggested to this company that the Ordnance Department, and perhaps Congress also, may have regarded the water-power so nearly finished that very little if any further appropriations would be needed in this direction. If this *be* so, it would be well for the Ordnance Department, and Congress also, to be apprised of what is *well* known here, that very large additional appropriations of money will be necessary to put the water-power into permanent condition to make it effective for Government use, and fulfill and keep its obligations to this company, and make it ready for transfer of power to the Government shops.

Had a different policy obtained in the original plans of improvement of power and location of shops, as was advised in connection with the use of water-power, there is no doubt a very large part of the past and prospective expenditures could have been avoided, and probably with results just as good, if not really better; but the remedy may be too late now, and whatever policy may be held by the Government on these questions, the water-power company cannot perceive why *its* interests, or the interests of large manufacturing establishments who have been induced (by the known agreements of Government) to settle in Moline and become dependent on water-power, or the interests of operatives, who by toil and frugality have secured homes, should be made or permitted to suffer because of this policy or that policy of Government, and it is unwilling to believe the Government will knowingly insist in acts of bad faith, and knowingly withhold fulfillment of contracts and obligations. And finally, the only apology that can be made for troubling you with this communication is the simple fact that this company made a fair contract with the Government after the fullest and most exhaustive discussion; that it has in good faith passed over its property to the United States; and that it now and ever will insist that the Government should fulfill its obligations in letter and in spirit, and regrets that it has not before pressed the matter, as is now proposed to do, before the Ordnance Department, and by appeal to Congress, should it become necessary.

I am informed by Hon. J. M. Gould, secretary of this company, who was recently in Washington and had an interview with you on the subject, that you are expecting to be at Rock Island soon, and would probably stay long enough to become familiar with the arsenal and surroundings. I would be glad to know when you will be here so that I can be at home, as I should be glad to meet you and talk over the matter in question.

With considerations of respect, I am, very truly, yours,

CHARLES ATKINSON,
President Moline Water-Power Company.

On the 8th of April, 1875, this letter was referred to me by the Chief of Ordnance for consideration and report, and was returned on the 6th of May, 1875, with a report, as follows:

I have the honor to acknowledge the receipt of a letter dated April 1st, 1875, addressed to you by Mr. Charles Atkinson, president of the Moline Water-Power Company, and referred to me for consideration and report. The letter is returned herewith, and respecting the same I have the honor to report as follows:

The papers necessary to an understanding of the obligations of the United States in this matter are all on file in the Ordnance Office, and are as follows:

Proceedings of Rock Island Commission, transmitted to Secretary of War by Chief of Ordnance in letter dated February 8th, 1867.

First agreement signed by Moline Water-Power Company, June 18th, 1867, transmitted by General Rodman to Chief of Ordnance in letter dated June 19th, 1867.

This agreement is signed on part of the United States by General Grant, August 20th, 1867.

Copy agreement dated April 8, 1869, transmitted by Chief of Ordnance to General Rodman in letter dated April 9th, 1869, signed by John A. Rawlins, Secretary of War, and Charles Atkinson, president of the Moline Water-Power Company.

I certainly believe that the obligations of the United States set forth in these papers have been thus far properly discharged, and somewhat liberally discharged, in the benefit conferred upon the Moline Water-Power Company, and that you should not feel that injustice has been done to this company by the United States.

The Government has certainly bound itself to develop and maintain the water-power. What this development and maintenance shall be is not exactly set forth, and has caused and probably always will cause discussion, because only one party to the benefits to be obtained has to expend the money for them.

The claim made in Mr. Atkinson's letter is that the wing-dam should be extended up the river to Duck Creek chain, a distance of two miles; that deposits should be removed from the water-power pool for the further improvement of the water-power; and that considerable sums should be appropriated by Congress for this purpose.

Deferring the consideration of the complaints made in the letter, I wish first to discuss this proposed further improvement of the water-power, because all the complaints made in the letter hang upon it.

The water-power in its present condition is certainly defective. I first noticed the defect three years ago last fall; have had occasion to observe it every fall and winter since that time, and have referred to it in my annual reports.

1st. At extreme low water the depth of water at the mouth of the pool is too little, and enough water cannot get into the pool. Generally if more than about one-third of the estimated power of the water-power is used at such times, the pool is "drawn down" too low. That is on account of the small cross-section of water at the mouth of the pool; the requisite amount of water cannot get into the pool without increased velocity because the amount of water passing in is the product of cross-section into velocity. Velocity can only be obtained by consumption of *head*, and whatever head is consumed at this point must be deducted from head at the dams. The extreme case would be when all the head is consumed in getting velocity, thereby converting the pool into a running stream, leaving *no* head at the dams and *no* water-power.

2d. The depth of water at the mouth of the pool is being constantly diminished by deposits. The current along the left bank of the river makes a curve at the mouth of the pool and passes around the head of the wing-dam, as shown on the map. The water which passes into the pool at once becomes (comparatively) still water, and begins to deposit its sediment. The deposit is greater when the water first stops at the mouth of the pool, and should form a bar there along the lower border of the currents shown by the map. This is what actually takes place. The deposit is then less and less as the amount of sediment in the water diminishes while the water moves slowly toward the dams, but there is some deposit all the way.

3d. When very low water lasts until winter, the extreme cold of this climate may freeze nearly *all* the water at the mouth of the pool and form an effectual dam so that no water may get into the pool, and there will be no water-power. In the winter of 1872–3 ice formed in the river to a depth of 40 inches. This has occurred during the past two winters, though the dam was partly formed of slush and floating ice, lodging under and upon the solid cake lying in the pool. To remedy this evil described above, Mr. Atkinson proposes to have the Government build a wing-dam to deep water at Duck Creek chain, a distance of 2.45 miles or farther, up the river. I have located on the map the proposed position of this wing-dam, as I have understood it from Mr. Atkinson in verbal discussions of the subject. The theoretical advantages which may be claimed for this plan are:

1st. That it would add to the head of the water-power the difference of level of the surface of the river between the head of the present wing-dam and the head of the

proposed wing-dam. (This is stated by Mr. Atkinson to be 2 feet, and is found by careful measurement to be 1.73 feet.)

2d. That it would raise the water at the present head of the pool the amount of this increased head, and give at that point always sufficient cross-section to let the required amount of water into the pool.

Not only on account of cost, but for other reasons, I am compelled to say I do not think this plan a good one. I have heretofore refused to discuss this plan officially, because I have not sufficient data. I have during the past two years made such soundings as I could about the shore of the island, the wing-dam, and water-power pool, with the view of making a thorough investigation of this subject, and hope during the coming summer to complete soundings of all the part of the river included between the line of the proposed wing-dam and the left shore. When this is done it will be possible to determine by close calculations very nearly what would be the effect of the long wing-dam. Without it, conclusions must be based upon opinions. I think, however, we may be certain of what follows:

By changing the position of the head of the pool we would simply change the position of the deposit described herein, and get a new sand-bar at the new head of the pool. It is the same difficulty that is contended against at the mouths of certain rivers, except that they have an outflow and littoral currents to wash away deposits, and we have not. Mr. Atkinson hopes that by removing this deposit to deep water at the proposed new head of the pool this difficulty will be overcome. It is simply removing the evil day, for the deposit will take place and the pool fill up. I think, then, the benefit to the head of the pool would be only a temporary postponement of the evil. What I regard as more important is that the new head of the pool being in deep water, it would enable us to dredge out the deposit, which we cannot do advantageously where the head of the pool now is, because the rock is near the surface. But I apprehend that more serious difficulties than we have to contend with now would arise from the long channel, or, properly, canal, which we should construct between the wing-dam and left shore. To make this canal of any use there would have to be enough depth of water at *every point* in the whole length of it to let all the water required for the power pass through it without much current. Without complete soundings I cannot say that this would not be so, but I think it highly probable that it would not. At any rate, we should have the same deposit going on along the whole length of this canal that is now going on in the pool, and sooner or later this canal will be choked up. (After complete soundings are made, the required velocity of current and head that would be consumed can be accurately calculated.) Then, instead of getting an increased head of 1.73 feet, more than 1.73 feet would be consumed by the necessary current through the long canal, and the water at the present head of the pool would be lower than in the main river outside the wing-dam. Then, unless the deposit and some rock at the head of the present head of the pool were removed, no water at all could get through to the dams. Moreover, we should then have the long route of 2¼ miles to clean out and take care of, instead of the present short route of less than ¼ mile. I should say, then, that if it were not the great cost of the work, this might be a good plan for putting the water-power in condition to make it sell well; but for the long future of the water-power it would be a bad plan. I believe the simple, the best, and much the cheapest plan for remedying the defect in the water-power would be to dig a good channel from near the head of the wing-dam we now have to a point as far down the pool as soundings shall show to be necessary. On the accompanying map deep water is shown between the blue shaded lines. Between these lines the depth is nowhere less than 4 feet at extreme low water. (The depth here referred to is depth to the rock.) At S S′ it will be seen that the wing-dam cuts across this deep water. On the pool or south side of the wing-dam this deep place is now filled with deposit, and I have not enough rock soundings to follow it. I believe, however, it is the beginning of the old or ancient channel which ran to the left of the island. I believe it would be best to tear up the wing-dam to the point S, and to throw the current more into the pool, and possibly raise the water a few inches by running the wing-dam out to H, as shown on the map. This channel should be made good as far as it is shown on the map. Rock excavations would be required at several places, and where required the space should be coffered and the work thoroughly done. Of course this channel would in time be choked with deposit, but it would have a smooth bottom and sufficient depth for successful and economical dredging. Moreover, I believe that when the sluice or wash gates that I have put in the new dam are opened at extreme low water so much current would be drawn into this channel that, by stirring up the deposit by mechanical means, the deposit could be washed out in this way. (This method of improving the water-power is consistent with a possible great development of the water-power in the distant future, should the wants of the arsenal or manufactures at this point demand it.) It is pertinent to this question that in the summer of 1874 an attempt was made to dredge out the deposits at the head of the pool. The deposits were so scattered over a wide surface, and the surface of the rock bottom so uneven, that generally

less than a quarter of a scoopfull could be taken up, and the benefit obtained was in consistent with the expenditure.

Returning now to Mr. Atkinson's letter, the principal complaint therein is, that, pending the complete development of the water-power, insufficient or rather considerable and expensive improvements have not been made at the head of the pool, (as contemplated herein, and which I certainly deem necessary,) for the sole benefit of the Moline Water-Power Company, which company has alone been using the water-power. The United States has not as yet used it at all.

It is made pretty clear in the contracts that the United States is not required to make expenditures, pending the development of the water-power for the benefit of the water-power company's use of the same, and the contracts state that the Moline Water-Power Company shall reimburse the United States for such expenditures.

I have certainly always wished and tried to do all that could consistently be done for the benefit of the Moline Water-Power Company, and certainly all that the contracts demanded. I think the contracts did not demand that this work should be done, and I have urged upon the water-power company the necessity for heeding the wisdom of policy. For reasons which need not be stated, I have deemed it unwise to ask Congress for further sums of money for the development of that part of the water-power, until the United States should begin to use the power. This argument that as the United States was not using the power, this expenditure was for the benefit of the Moline Water-Power Company solely, seemed strong and not easy to combat. I believe, then, that leaving this part of the work alone has not been a failure on the part of the United States to comply with its contracts, and that it was wisest and best for all concerned to complete the water-power and get it ready for the arsenal to commence using it. If, then, it could be proved that the wants of the arsenal and economy demanded the further development of the power, as I believe it will, the work could and should be done, and in the mean time, by making necessary soundings and investigations, the best method of doing the work could be determined. In several discussions of the subject with Mr. Atkinson and members of the Moline Water-Power Company I have urged these views upon them, and supposed until lately that they consented to them. Mr. Atkinson complains of the plan or form of wing-dam now built. I know of nothing in the contracts which requires that the wing-dam should have been built in any other way. It was built by General Rodman in the years 1867 and 1868, and it is pretty certain that he took pains to so build it that the greatest benefit to the water-power that he could get would result from the expenditure. The complaint that deposits have not been removed from the pool as agreed, and for which appropriations have been made, seems hardly a fair one. I find no special appropriation for this work. In 1869 and 1870, 36,500 cubic yards of deposit were taken from the pool by the United States. Again, in the summer of 1874, $1,647.75 were expended in removal of deposits. No exact measurement of the amount taken out at this time was kept, but it was estimated at 2,300 cubic yards. This dredging was partly along the site of a coffer-dam which had been put in while building the upper dam (generally called Moline dam) of the water-power, and the remainder of it at the head of the pool. This dredging was done at the request of the Moline Water-Power Company, and, as far as practicable, in accordance with the company's advice and wishes. As heretofore stated, the dredging was not very successful, on account of shallow water and the wide spread of the deposit on rocks near the surface. The site of the old coffer mentioned above is supposed to be what Mr. Atkinson calls the obstruction put in by the United States. This old coffer was reported to have been thoroughly removed while General Rodman was in command of this arsenal. The soundings made at the time of the dredging mentioned here, the dredging, and subsequent observation, convince me that the coffer is so thoroughly removed that it is not an obstruction.

I would respectfully call your attention to my letter, dated January 9th, 1872, respecting a division of the water-power, and the collecting of rents from the water-power company, as provided for in the contracts, and suggest that, if it be legal, possibly the money received for rent might be sufficient to keep the head of the pool clear, after a channel has been made as proposed in this letter. This would avoid the necessity of applying to Congress frequently for money specially for maintenance and care and preservation of the water-power.

In May, 1875, the Chief of Ordnance, Brig. Gen. S. V. Benét, visited the arsenal, made a thorough inspection of the water-power, and had protracted discussions with the Moline company respecting matters discussed in the foregoing correspondence and the completion of the water-power development at the head of the water-power pool. At that time the Moline company signified their willingness to make a proposition to enter into a new agreement with the United States whereby the United States should relinquish to that company a portion of the water-power and that then the Moline company would itself put in the long wing

dam proposed by the officers of the company, or so much of it as they should find necessary or advantageous. This proposition was not acceptable to the Chief of Ordnance, and was not favorably considered.

During the succeeding summer and fall I had frequent discussions with officers and members of the Moline company on the subject, that company still advocating that some plan be arranged by which they could be allowed to put in the long wing-dam and acquire thereby a portion of the water-power.

I was strongly opposed to any such plan.

1st. I did not believe that the proposed wing-dam would so develop the water-power as to make it satisfy the wants or suit the interests of the United States.

2d. I thought it would be extremely unwise for the United States to relinquish any portion of the water-power. It was, and is now, too late to discuss the wisdom of the first purchase and development of the water-power. The purchase had been made under other officers of the Government, and the development about completed. It had probably cost the United States more than it was worth, but the purchase and expenditure, wise or unwise, had been made and could not be unmade. The United States had thereby acquired a very valuable property. If not worth all it had cost, it was, and is, a property already acquired, suited to the wants of, and a part of the plans for, this great arsenal, and necessarily of the utmost importance to the United States. I believed it to be a duty, in serving the interests of the United States at this place, to urge that the United States should hold this property, fulfill its contracts with the Moline company, and, in all things to be done, keep in view and adhere to a plan which will put and keep the water-power in such condition that, when the time comes, if it should ever come, that the life of the nation needs the service of this great arsenal, the water can at once, quickly, and with certainty, be put in such a condition that it can drive the arsenal-shops. It would not be economy, and I believe it would not now be practicable, to procure the means of providing any other certain power for driving the shops.

In all discussions with the water-power company I have tried to maintain these views. In the winter of 1875 and 1876 the water-power company determined to lay the matter before the Secretary of War, and, if possible, to procure some action that would relieve them from their difficulties, and I was directed by the Chief of Ordnance to report to him in Washington, to meet the officers of the company there. During the preceding summer and fall I had completed the soundings and examination of the water-power pool and river above, and had prepared charts and maps and a full report covering the matter under discussion. These were taken to Washington by me in February, 1876, and in several interviews which the officers and attorney of the Moline company had with the Secretary of War and the Chief of Ordnance the whole matter was discussed. The result of these discussions was that the Chief of Ordnance recommended that application be made to Congress for the necessary appropriation to do the work required to complete the water-power, and this was approved by the Secretary of War.

The report referred to above, and the action taken thereon by the Chief of Ordnance and Secretary of War, are as follows:

(The charts and map which accompanied the report are not copied, but all that is necessary to a full understanding of the matter is shown on the map on Plate XI.*)

*This report and the indorsements thereon were published by the Chief of Ordnance in his annual report for the fiscal year ending June 30, 1876.

WATER-POWER AT ROCK ISLAND ARSENAL.

WAR DEPARTMENT,
Washington, D. C., February 19, 1876.

SIR: I have the honor to transmit, for the consideration of Congress, a communication from the Chief of Ordnance, inclosing a report by the commanding officer, Rock Island arsenal, asking for an appropriation of $157,350 to complete the development of the water-power.

The agreement entered into by my predecessors under the joint resolution of Congress of March 2, 1867, makes it the duty of the United States to carry out this work to completion, and the interests of private parties require that the work should be done as speedily as possible. The whole appropriation asked for would enable this Department to complete the work and afford the relief called for in a few months, and thus fulfill the engagements entered into by the United States.

Should the full amount not be appropriated, as asked for by the Chief of Ordnance, the sum of sixty thousand dollars at least should be given, in order to enable the Department to make progress in the work.

Very respectfully, your obedient servant,

WM. W. BELKNAP,
Secretary of War.

To the SPEAKER HOUSE OF REPRESENTATIVES.

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, February 17, 1876.

SIR: I have the honor to transmit herewith a report of Maj. D. W. Flagler, commanding Rock Island arsenal, showing the necessity for an appropriation for completing the development of the water-power.

The agreements made by the United States with the Moline Water-Power Company bind the former under the obligations hereinafter stated.

1st. Proceedings of Rock Island commission of January 24, 1867, (Executive Document 27, Senate, 2d session 39th Congress,) which requires "the Government to develop and maintain the power, so far as it can be done with the money heretofore appropriated, or that which may hereafter be appropriated by Congress for that purpose. The Moline Water-Power Company to have the use in perpetuity * * * of one-fourth of the entire water-power developed" * * *.

2d. Agreement with the Moline Water-Power Company, signed by General Grant, Secretary of War *ad interim*, and Charles Atkinson, president water-power company August 20, 1867, in which the company convey their "entire water-power" and the free use of so much of the bed of the river as may be required "for the further development of said water-power."

The Moline company be granted the free use of "one-fourth of their entire water-power above conveyed." The United States agreeing to apply "$40,000, or so much thereof as the War Department may consider necessary, to complete the wing-dam," &c.

3d. Agreement between the Moline Water-Power Company and Secretary Rawlins, dated April 8, 1869, which stipulates that the United States shall "resume * * * the development and prosecute to completion, &c., the upper portion of the water-power and the removal of the deposits in the pool."

Upon this subject Major Flagler, in his report of May 6, 1875, to the Chief of Ordnance, says: "I certainly believe that the obligations of the United States set forth in these papers have been thus far properly discharged, and somewhat liberally discharged, in the benefit conferred upon the Moline Water-Power Company, and that you should not feel that injustice had been done to this company by the United States. The Government has certainly bound itself to develop and maintain the water power. What this development and maintenance shall be is not exactly set forth, and has caused, and probably always will cause, discussion, because only one party to the benefits to be obtained has to expend the money for them." And further, it is a nice question to decide to what extent the development and maintenance shall go on, and whether the Government, which pays the expenses thereof, shall not be the judge of the manner and quality of such development and maintenance. At any rate, the action of this Department is limited by the appropriations, and I have no doubt that full justice has been done to the interest of the Moline Water-Power Company. The necessity for further appropriations is apparent, and this bureau has estimated for the next fiscal year, as follows:

(Book of Estimates, page 124.)

"Improvement of the water-power ..... $60,000.

"NOTE.—This estimate is for opening a channel in the rock bed of the river and improving the wing-dam, to increase the amount of water flowing into the water-power pool during low water

This sum, however, is not sufficient to complete the work as wisdom and economy demand that it should be done, as is shown in the report transmitted herewith.

The Moline Water-Power Company feel aggrieved because the quantity of water at its disposal is not sufficient. It is admitted that the passage to the pool is obstructed, and that to give the Moline Water-Power Company, and the United States, the full benefit of the development already made, measures must be taken to cause a sufficient flow of water into the pool to supply the necessary power. The Government is bound by its agreement (after taking possession of the water-power property) to do this work, and in the interest of the two parties interested, for economy, and particularly for the protection of valuable interests to the United States, the work should be done now, and the entire amount, $157,350, should be appropriated.

Two methods are proposed for doing this work. Major Flagler's report, transmitted herewith, fully proves that the proper way to effect the object is by carrying out the plan proposed in that report, that it will for the least money satisfy most of the conditions and give all the water necessary for the company and the United States, and make provision for dredging out the channel, and at all times keep the work in working condition. This plan, No. 2, is therefore approved and recommended, and the money required, $157,350, should be asked from Congress at the present session.

This matter is respectfully recommended to the honorable Secretary of War for favorable action, and that it be brought to the attention of Congress.

Very respectfully, your obedient servant,

S. V. BENÉT,
Brigadier-General, Chief of Ordnance.

The honorable THE SECRETARY OF WAR.

REPORT OF MAJOR D. W. FLAGLER.

ROCK ISLAND ARSENAL, ILLS., *February* 4, 1876.

SIR: Referring to my letter to you, dated May 6, 1875, respecting the deposits at the head of the water-power pool at this arsenal, the difficulty of getting a sufficient supply of water into the pool, complaints of the Moline Water-Power Company, &c., and to the item of $60,000 in my annual estimate for the fiscal year ending June 30, 1877, for prosecuting the development of the water-power by making provision to admit the necessary amount of water into the pool, I have the honor to submit, for your information and consideration, the following calculations and remarks:

The following is the amount of water required for the water-power for which a water-way into the pool should be provided:

Provision should be made to furnish to the United States at least 2,000 horse-power.

The best plant of water-wheels, pen-stocks, and machinery cannot utilize more than 78 per cent. of the power of the water. At low water the head at the dam is 7 feet. This would require for the use of the arsenal 3,234 cubic feet of water per second,

$$\frac{2{,}000 \times 550}{0.78 \times 62.3 \times 7} = 3{,}234.$$

The contract made with the Moline Water-Power Company requires that one-third as much more be provided for the use of that company. This makes the total amount required 4,312 cubic feet per second. I think it best to put this amount at 4,400.

It is the object of this paper to determine the best method of getting this amount of water; that is, of getting it from the river into the pool. As explained in my letter of May 6, 1875, the water cannot get into the pool now because of obstructing rocks and deposits of mud and sand. The removal of these deposits would be very expensive, is nearly impracticable, and would not be effectual in producing much lasting good.

It is, therefore, necessary to provide some other way.

Whatever plan is adopted, it should possess as many of the following requisites of a good plan as is practicable:

1st. It should be as economical as may be.

2d. It should be effectual.

3d. It should be such as will prevent future deposits of sand and mud, or such as will admit of the easiest and most economical removal of these deposits, which, unless prevented, must continue forever.

4th. The development of this part of the water-power must be such as not to prevent a future increase of the water-power, but should be such as to make such an increase as easy and economical as may be.

The future manufacturing interests of this community, and the probable future wants of this great arsenal, make attention to this last requisite important.

After discussing the only two plans of development that are proposed, and making calculations and estimates for them, it will be well to see how far each fulfills the above requirements.

FIRST PLAN, OR THAT OF BUILDING A LONG WING-DAM UP THE RIVER.

You are aware that the president and members of the Moline Water-Power Company have advocated the building of a long wing-dam up the river. The proposed location of this dam is shown by a red line on the accompanying map, marked "A."

It is claimed for this plan that, by running the head of the dam into deep water, it will give so large a cross-section at the head of the pool (A B on map) that enough water will always enter the pool, and that, also, this dam will raise the water in the pool nearly to the height of the river at the head of the dam. The level of the river at the proposed head of the dam (A B on the map) is 1.6 feet higher than at the present head of the pool, (C D on the map.) It is further claimed that this increased height would carry the water over the obstructions which are now at the head of the pool, thus remedying the present evil, besides giving an increased head and a large increase of power at the water-power dams.

I have been unwilling to adopt this plan until after a thorough examination and study of this part of the river could be had.

It will be readily understood that this plan, instead of making a pool all the way to the head of the proposed wing-dam, would substantially make a canal between the wing-dam and the Illinois shore, down which all the water for the water-power would have to be brought. This canal would be more than two miles long and generally about 900 feet wide. The water in all this part of the river is shallow. I have been afraid from the first that to get enough water to flow down this long shallow canal so much fall in the surface of the water would be required that nearly all—all or more than all—of the increased head, viz, 1.6 feet, would be consumed in this way; that is, that the slope of the surface of the water in the canal would be greater than outside in the river. If this were so, then at low water the wing-dam would dam the water out of the pool; the water in the pool would be lower than it is now; none of the benefits claimed for the plan would be gained; but great damage would be done.

During the last two years I have given much attention to this subject.

Last fall I finished complete soundings and measurements of all this part of the river. These soundings are numerous and accurate, embracing in all about 15,000 soundings. From them I have made cross-sections of the proposed canal, 200 feet apart, throughout its whole length, and from these cross-sections determined the capacity of the canal. The canal at low water would have an average depth of not much more than 1.2 feet.

Obstructions and the uneven bottom would produce eddies and *contractions*. I have, from a study of the cross-sections, determined as nearly as possible the form of bottom and sides of a canal of equal capacity for *flow*, but of a uniform cross-section at low water, and have calculated the *flow* in the latter. Of this canal the area of cross-section would be 980 square feet; the length of *wet perimeter*, 880 feet, (approximately;) length of canal, 12,500 feet.

(a) To discharge 4,400 cubic feet per second through this canal, the required fall is determined by calculation to be $26\frac{5}{10}$ feet; that is, it would be impossible.

(b) If we suppose the fall in the canal to be the same that it is in the river outside—viz, 1.6—the canal would discharge $1{,}001\frac{78}{100}$ cubic feet per second, representing at the upper dam $907\frac{8}{10}$ horses' power. To get even this we would still have to clear a channel through the rock and mud at the head of the pool.

(c) With the stage of water 1 foot above low water, to discharge 4,400 cubic feet per second, there would be required a fall of 3.598 feet, leaving the water in the pool still nearly 2 feet lower than the river outside. With this stage of water, the wing-dam would still injure the water-power, if the maximum amount of water for which the water-power was built (4,400 cubic feet per second) were required.

$$\text{(a) Fall in feet} = \frac{\left(\frac{4400}{980}\right)^2 \times 880 \times .0001114 \quad \frac{4400}{980} \times 880 \times .00002426}{12{,}500} = \frac{\qquad\qquad + \qquad\qquad}{980 \qquad\qquad 980}$$

Fall in feet = 26.50.

$$\text{(b) Discharge per second} = 980\left(\sqrt{\frac{980 \times \frac{1.6}{12{,}500} \times 8975}{880}} - 0.1089\right) = 1001.78 \text{ cubic feet per second.}$$

$$\frac{1001.78 \times 62.3 \times 7 \times \frac{8.5}{100}}{550} = 907\tfrac{8}{10} \text{ horse-power.}$$

$$\text{(c) Fall in feet} = \frac{\left(\frac{4400}{1880}\right)^2 \times 880 \times .0001114 \quad \frac{4400}{1880} \times 880 \times .00002426}{12{,}500} = \frac{\qquad\qquad + \qquad\qquad}{1880 \qquad\qquad 1880}$$

Fall in feet = 3.598.

With the stage of water 1.45 feet above low water, to discharge 4,400 cubic feet per second, the required fall in the canal would be 1.6 feet, the same as in the river outside, and no damage would be done by the wing-dam. As the river rises above this stage, the wing-dam, if built high enough, would begin to be beneficial.

It is to be remembered, however, that the supposed improvement is only desired or needed at low water. If the determined cross-section of the canal is correct, or anywhere near correct, then the calculations prove positively that at low water the wing-dam would dam the water out of the pool and effectually destroy the water-power.

Nor is this the principal injury that the wing-dam would effect. From the instant that it is completed the deposits in this channel must commence. It is impossible that the deposit should be less than it is now; and, even if the canal were a good one to begin with, sooner or later it must be filled up, precisely as the head of the pool is now. Then, instead of having, as we have now, the objectionable difficulty of clearing out a channel 2,400 feet long through the mud and rock, we should have the increased difficulty of clearing out and keeping clear a similar channel 12,500 feet, or nearly 2¼ miles, long. The expense of this last undertaking would make it impracticable.

Moreover, the deposit must be much *greater* than it is now. We have now the deposit only from the still water that comes into the pool. The wing-dam would give us additional deposits from the other water that does not come into the pool. It is proposed to build the wing-dam to a height of not more than 3 feet above low water. At higher stages, when the water is most charged with sediment, the river is to flow over this dam. It will then be like any other obstruction at the bottom of the Mississippi that causes a bar to form above and below it. The fillets of water below the level of the top of the dam will have from little to no current; will receive a portion of the sediment from the running water above, and, being too sluggish to carry it away, will deposit it. I believe the deposit abstracted from this water which we would not use, and from which we would get no benefit, would be more than we now get from the water which comes into the pool and which we do use.

Some plans are proposed for washing out this deposit. They might mitigate the evil, but that they would succeed sufficiently to keep the water-power in operation at low water is, I believe, subject to grave doubt.

COST.

To build the dam to the height of 3 feet above low water, of loose rock dumped in the river, (the cheapest construction,) would require, according to my estimate, 75,000 cubic yards, and cost $225,000.

It has been proposed to deepen the canal between the wing-dam and the shore, increase its cross-section, and thus avoid the evil of injuring or partially destroying the water-power at low water, as shown by the calculations herein, and to use the rock thus obtained for building the wing-dam.

This would be effectual, and is, on a larger scale, substantially the same as the other plan proposed; but to do it, it would be necessary to coffer and pump out all of this part of the river. The expense would be very great and incompatible with the benefit obtained. The increased deposit, described on the preceding page, would still obtain. It is true that the excavation would give a smooth channel which might be dredged, but instead of having a lesser amount to dredge from a channel 2,400 feet long, there would be a larger amount to dredge from a channel 12,500 feet long.

To make this channel at all valuable, that is, to deliver the required 4,400 cubic feet per second and increase materially the height of water in the pool, would require at low water that the excavation clear a channel 4 feet deep and 800 feet wide. This channel would require a fall of .53 feet and save 1.07 feet of head. Its cost would probably exceed $750,000.

If this plan of excavating is abandoned on account of its cost, I should say then that at low water the wing-dam would injure the water-power; that if provision is to be made to bring into the pool the required 4,400 cubic feet per second, then the wing-dam would injure the water-power for any stage of water less than 2½ feet above low water; that in any case it would multiply the difficulty and cost of keeping the water-power in good condition; that it would benefit the water-power when the stage of water is 3 feet above low water and the benefit is not needed, because then it can be obtained by other inexpensive means; that at stages of water between 1 and 3 feet above low water, if the arsenal is using little or no water and the Moline Water-Power Company is using only about 750 horse-power, then that company would get material benefit from the plan in increased head, provided that the United States keeps the water-power in order.

SECOND PLAN.

The other plan proposed is to excavate a channel from deep water near the head of the wing-dam now built down through the pool until deep water is reached. (See MM' on the map.) It is proposed to make this channel 400 feet wide, 3½ feet deep, about 2,400 feet long, and to use a portion of the rock obtained in extending the wing-dam

now built about 500 feet (shown on map) up stream and out into deep water. This extension of the wing-dam would be into deep water where the current is rapid, and should turn a part of the current into the pool, and would raise the water a few inches at this place. I estimate this raise at .32 foot, which would give a little more than 3.8 feet of water in the channel excavated.

As has been stated, there is now a deposit of mud and sand over all the head of the pool which dams the water out of the pool. Underlying this deposit is rough, uneven rock, coming sometimes near to the surface of low water. A channel cannot be dredged through it, because the rock interferes. To dredge out the deposit over all the head of the pool would be difficult, expensive, and nearly impossible, because of the uneven rock bottom. It would not be effectual, because the deposit would soon return in the same objectionable form. The object of the proposed channel through this mud and rock is to furnish, first, a sufficient water-way into the pool, and, second, an effectual and economical method of maintaining the water-way. To determine the sufficiency of this water-way, the calculations for flow through it give the following results:

To discharge through it the maximum amount to be provided for, viz, 4,400 cubic feet per second, would require at low water a fall of .59 foot. To discharge the same amount through it with the stage of water 1 foot above low water would require a fall of .33 foot; with the stage of water at 2 feet the fall would be .16 foot, or practically nothing. This supposes the channel to be clear of deposits.

Ordinarily the maximum amount of water would not be required. A considerable deposit in this channel might then exist and the capacity of the channel remain sufficient. In time of peace the amount of water used by the United States will be small. At such times, for many years to come, I suppose the combined consumption of both the arsenal and the Moline Company would not exceed 1,750 cubic feet per second, equivalent to 1,110 horse-power.

To discharge this amount through the channel, having in it a deposit 2 feet deep at extreme low water, would require a fall of .48 foot. With the stage of water at 1 foot, the required fall would be .12 foot. With the stage of water at 2 feet, the required fall would be .045 foot, or practically nothing.

Therefore, in time of war, or if at any time the arsenal required a large amount of power, the channel would have to be kept clear. At other times a considerable deposit could be allowed to accumulate and the water-way still sufficient. It would be better if the depth could be increased to 4 feet; but the additional depth would cost about $40,000.

2d. The channel is also to afford an effectual and economical method of *maintaining* a water-way. If the use of the dredge cannot be avoided, then the channel would permit that the deposit be allowed to go on till it is deep, and the dredge can get a full scoop and work economically. It would confine the dredging to a narrow channel, and give a smooth bottom to dredge over. Moreover, I hope it may prevent the necessity for dredging, or, at any rate, reduce very much its amount and expense.

I have provided in the lower dam four large sluice or wash gates, which can be opened against any pressure of water. The other gates can be opened against the pressure of low water. By opening all the gates not in use, in both dams, a strong, rapid current would be drawn down through the proposed channel. Then, by stirring up the mud and sand in the channel by mechanical means, it is probable that the deposit might be washed out and its accumulation controlled in this way without much expense. This could be done from Saturday to Monday, when the water-power is not used.

COST.

My estimate of the cost of excavating this channel is as follows:

600 yards of coffer-dam, at $7 per yard	$4,200
1,100 yards of mud coffer, at $1 per yard	1,100
Pumping out water	350
Excavating 58,000 cubic yards of mud and sand, at 30 cents per yard	17,400
Excavating 52,000 cubic yards of rock, at $2.50 per yard	130,000
Removing coffers	1,300
Tramways, scows, and other expenses	3,000
Total	157,350

It is proposed to apply to this work whatever appropriation Congress makes for this object, and to prosecute the work as indicated as fast as appropriations for it can be obtained. A less amount than that asked for could not be applied so economically as the whole amount.

I believe it would be unwise, and not economical, for the Government, after having expended so much money and built so great a water-power, to leave it unfinished. It is also clear that the acts of Congress on this subject, and the contracts made with the Moline company, require that the work shall be done.

Comparing this second plan with the first one proposed, I think it is clear—

1st. That it is more economical than the first plan, provided the first plan be made effective.

2d. That the second plan will be effective at low water, the only time when it is needed, and that at any reasonable cost the first plan cannot be made sufficiently effective to give at low water the maximum amount of water required.

3d. That the second plan admits of satisfactory and economical methods of removing the deposits that will always occur; and that the first plan would increase these deposits, and would furnish no satisfactory or economical method of getting rid of them.

4th. If the first plan were carried out, it seems to admit of no future increase of the water-power, except by digging out, through rock, the channel 2¼ miles long, between the proposed wing-dam and the Illinois shore; a work so expensive that I doubt if it would ever be undertaken.

If the second plan is carried out, and at any future time (50 years hence) the wants of the arsenal and manufacturers in this region demand it, certainly the water-power can be increased, at a reasonable cost, by deepening the channel.

In the calculations for *flow* in the channel between the proposed wing-dam and the Illinois shore, (first plan,) the cross-section of available channel was taken, for low water, at 980 square feet. If this cross-section is correct, then the results obtained in the calculations for flow are very nearly correct. It may be claimed that this cross-section is too small. Certainly if a larger cross-section is the true one, it would give better results. But, discarding all calculations, this much is true: The discharge of the Mississippi at this point at low water has been carefully measured and calculated, and is not more than 17,000 cubic feet per second. Not more than one-tenth of this flow is in the part of the river under consideration, at extreme low water. To partition off this part of the river from the rest could not in any way increase its flow. Leave the slope of the surface the same that it is now, and the discharge is 1,700 cubic feet per second, equivalent to about 1,100 horse-power.

The water in the pool cannot be raised without diminishing the slope or fall of the channel above. To diminish this, means diminish the flow and diminish the horse-power. Building the wing-dam would then confine us to 1,100 horse-power as a maximum. It would dam us off from getting any more, and to get this an opening would have to be cut down through the rock and deposits now at the head of the pool.

If, however, the water-power is to be reduced to, say, 1,000 horse-power, and be constructed for the present needs of the Moline company only, then the slope in the channel above can be diminished; the surface of water in the pool will be raised, and the small increase of head at the water-power dam, so much desired, will be gained. But the deposit will at once commence, and, unless cleaned out, will sooner or later reduce the power at low water to 0.

I regret the length of this paper, but the subject could not be very well explained in less space. As it is, much has been left out that is pertinent to the subject. The matter could be explained verbally much better while using the maps and drawings.

Very respectfully, your obedient servant,

D. W. FLAGLER,
Major of Ordnance, Bvt. Lieut. Col., U. S. A., Commanding.

To the CHIEF OF ORDNANCE,
United States Army, Washington.

No appropriation for the work recommended in the foregoing report and the indorsements thereon was made by Congress before the close of its session that year, and as the matter was still before Congress, and the necessity for the work still continued and was more urgent, in my annual estimate for funds required for the arsenal for the fiscal year ending June 30, 1878, I made the following remark:

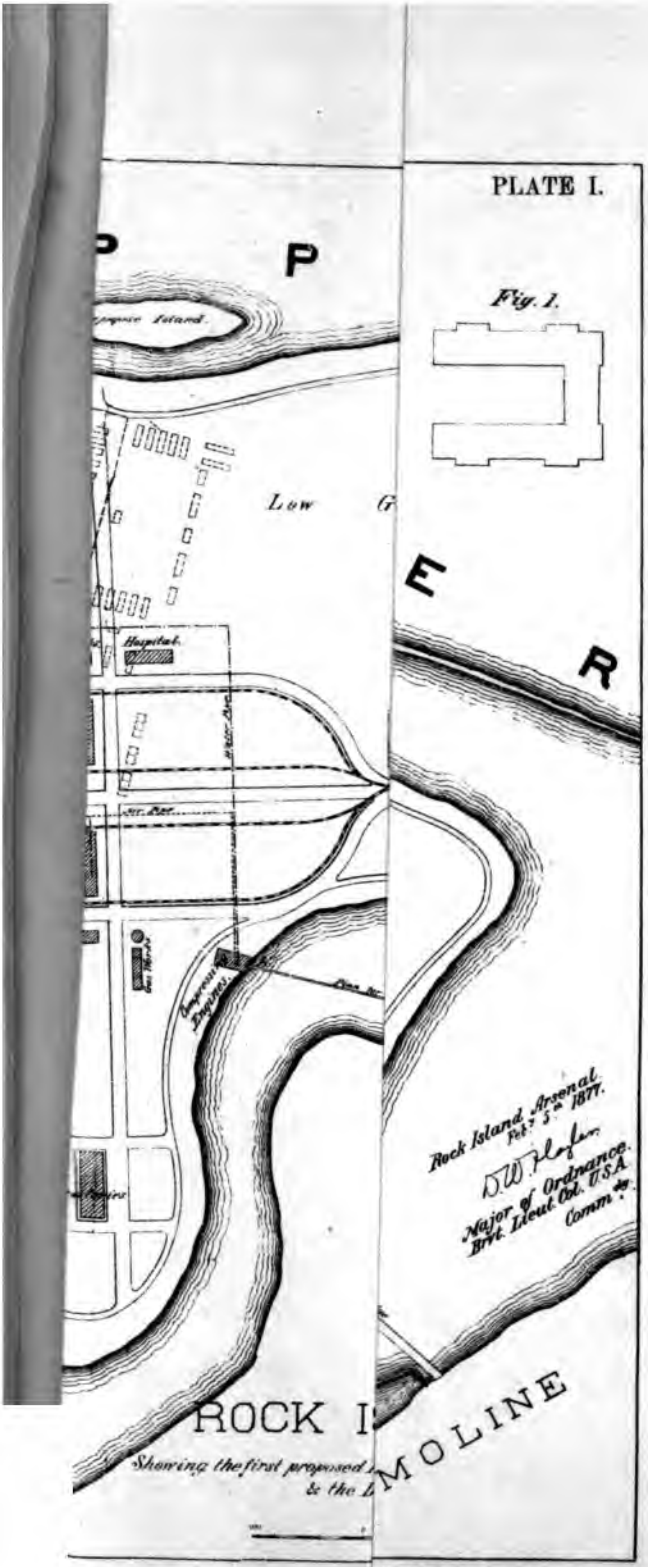
No estimate is made for completing the water-power, and this is left for such action as the Chief of Ordnance may deem best. I believe that wisdom and policy require that the work should be done without delay. The whole matter is discussed and the estimate for the work ($157,350) is given in my communication to the Chief of Ordnance, dated February 4, 1876.

The work can be done more economically by doing all of it in one year, as otherwise coffer-dams would have to be taken out and put in, pumping done, and some other expenses incurred each time the work is renewed.

In his annual report to the Secretary of War for the fiscal year ending June 30, 1876, the Chief of Ordnance, Brig. Gen. S. V. Benét, made the following remarks and recommendation respecting this estimate and the matter involved:

WATER-POWER AT ROCK ISLAND ARSENAL.

On the 17th of February last I had the honor of submitting to the Hon. Secretary of War my report on the necessity for a special appropriation of $157,350 for completing the development of the water-power, inclosing a report thereon from the commanding officer of the Rock Island arsenal. These reports were approved by the Secretary of War and transmitted to the House of Representatives on the 19th of February, 1876. This item is included in the estimates from this office for the year 1878, and the necessity and propriety for an appropriation are fully set forth in the papers herewith submitted. This appropriation is required to carry out the agreements entered into by the Secretaries of War under the joint resolution of Congress of March 2, 1867, and there is no doubt that the interests of private parties require speedy action on the part of the United States. The work can be done more economically if the whole amount asked for be appropriated, and this is earnestly recommended.



Rock Island—Appendix H, 1877.

June 30, 1875, and June 30, 1876,) in describing the foundations of Sh
F. It is very tough, indurated nearly to the hardness of slate, imper
ous to water, and homogeneous throughout. I have not found the b
tom of the deposit, though I have made excavations 14 feet deep in
It furnishes good foundations, but it would have been more satisfact
if good rock could have been obtained.

Before deciding to build on the clay, I excavated and examined it
a depth of 14 feet along the south line of the east wing, and also tes
it to determine the amount, if any, of settlement that might be ant
pated if walls were built on it. These tests gave excellent results,
the experience with Shop F has shown that the foundations are g
and satisfactory. Where this material was built on, it was excavate
feet wide and to a depth of from 3 to 6 feet, the depth varying in or
that a good, level foundation-bed might be obtained, and then this
cavation was filled, or partly filled, and thoroughly rammed, with a c
fully compounded concrete. It is believed that this will thoroug
protect the foundations from any injurious action of water. But
protect the foundations still further in this respect, I have packed
excavated clay against the masonry foundation-walls, above the conc
walls, (still below the level of the basement floor of the shop,) and
this have buried loose rock, which furnishes an underground drain
leading into the low grounds south of the shop. This drainage will
preserve the basement paved floors from moisture.

After excavating the indurated clay, and before building on i
made borings from 10 to 20 feet, at intervals generally of 30 f
to ascertain the character of the strata below. If rock was obtai
the excavations were continued and the foundations were laid in
rock. A record of the borings, and of materials found or strata pas
through, is preserved.

On the concrete walls (8 feet wide) described above, a rubble wa
built, with sufficient batter to reduce the thickness of the walls to 4
9 inches under the footing-stones. The footing stones are of so
selected Joliet limestone, 12 inches thick, 4 feet 4 inches wide, an
varying lengths, not less than 4 feet. Their surface is flush with
surface of the basement-floor, and on them is built the walls of the sh
3 feet 9 inches thick for the basement-story. The same constructio
that described above was pursued in building the foundations of
piers. When they are built in the indurated slaty clay described ab
a boring was first made in each, then a bed of concrete 8 feet sq
was put in and a rubble masonry wall built on the concrete, with a
ter reducing it to 4 feet 9 inches square under the footing-stones.
latter are 4 feet 4 inches square, and on them the piers will be built.

The maximum weight that would be placed on these piers, if all
floors of the building were loaded to their full strength, is 125 tons,
tons per square foot of foundation area. It is not probable that t
will ever be loaded with two-thirds of the above weight.

In the tests of the clay it was loaded with 9 tons per square foo
three different places, and, at the expiration of 56 hours, no sens
settling could be observed.

Drawings marked "D" and "E," transmitted herewith, give the de
of construction of the foundation-walls, and also the strata passed thro
in making excavations.

A considerable saving in cost of excavation for foundations
effected on this building over that incurred for the same work on
other shops.

Instead of shoveling up the material from stage to stage, as has b

done heretofore, the derrick-tracks were laid and the crane-derricks set up, which will be used hereafter in building the basement-walls, and with these, using horse-power, the material was hoisted out of the *deep* excavations with dump-buckets and dumped on wagons; two bucket fuls making one wagon-load. I estimated the saving of cost in removing material effected by this arrangement to be not less than 50 per cent. The derricks also furnished an economical means of putting the concrete and masonry walls in the deep excavations.

All the footing-stones required for the building were purchased during the year, and were set as far as the foundations were completed; $336\frac{259}{1000}$ cubic yards of dimension-stone were also purchased, and a portion of it cut, and the area wall along the north front of the building was built.

CARE AND PRESERVATION OF BUILDINGS, IMPROVEMENT OF GROUNDS, ROADS, ETC.

The work which has been done under this head during the year is principally the following: Repairs and painting of permanent buildings and repairs of roads; repairs of water-power gates, and some small repairs of water-power; prosecution of construction of avenues, gutters, and laying stone walks; the grading of the grounds along the site of the old railroad-track across the island; the construction of a gun-yard, and the planting of trees.

The principal work done on avenues and streets was on Main avenue. A portion of this avenue has been graveled, and trees planted along nearly a half mile of it; a considerable amount of work has been done in grading, dressing with loam, and sodding the slopes of the cuts and embankments along its sides; a paved stone gutter one mile long has been built along the entire north side of the avenue, from West avenue to the entrance gates, and thence along the east side of Rock Island avenue to Rock Island wagon-bridge causeway, (see map transmitted herewith,) also 5,200 linear feet of flag-stone walk, 4 feet wide, has been laid along this avenue and Rock Island avenue. This, with about 900 feet built in the preceding year, makes a complete stone walk along Main avenue from West avenue to the entrance to the bridge to Davenport, and from the intersection of Rock Island avenue with Main avenue to the causeway of the Rock Island wagon-bridge.

Along the site of the old Chicago, Rock Island and Pacific Railroad track, south of Main avenue, was some uneven ground, consisting of the embankments of two old disused railroad-switches; some disused roads, remnants of the embankment of the old Chicago, Rock Island and Pacific Railroad; pits containing standing water, from which the earth for the embankments had been taken, and mounds of material taken from the river by the railroad company in removing their embankment. The whole place was overgrown with weeds and underbrush; was very unsightly and unhealthy. These embankments have been removed, the pits and swamps and some old quarries filled up; the surface dressed with loam and prepared for grass, and some roads and drives laid out through it. In grading this ground 5,155 cubic yards of earth was moved.

Prior to the last fiscal year no permanent gun-skidding had been built at this arsenal. The 411 field and siege guns on hand were on wooden skidding which had rotted, and the receipt of 955 more guns from the Saint Louis arsenal last winter made it necessary that gun-skidding should be provided.

A site for a gun-yard was selected near the center of the island, and

an area of 262 feet by 175 feet cleared away evenly, graded and sodded. On this have been constructed nine lines of permanent gun-skidding, each 200 feet long. The rails are 6¼ inches cast-iron deck-beams resting on cut-stone piers. The rails were cast in the arsenal foundry.

Detail drawings and descriptions with details of cost of this skidding were sent to the Ordnance Office with my letter of December 22, 1876, and I respectfully ask that the drawing may be filed with this report.

Rows of trees were planted around the gun-yard, a permanent shot-bed, to extend around the entire yard, was nearly completed during the year, and a chain fence to inclose it was commenced. When completed the gun-yard will add much to the appearance of the grounds, and the skidding that has been constructed will probably supply all the future wants of the arsenal in this respect. A drawing of the gun-yard, marked F, is transmitted herewith.

The total number of shade-trees planted during the year is 830. These were nearly all planted along Main avenue and about the shops.

ROCK ISLAND BRIDGE.

The difficulties encountered during the year in maintaining proper order and government on the bridges in connection with their use by the public have been similar to those reported in previous annual reports.

The Davenport and Northwestern Railroad Company have laid their track and are now running trains across the Davenport approach to the bridge. The papers giving an account of this case were sent to the Ordnance Office October 26, 1876.

Following is an abstract of the records kept at the bridge during the year:

Passing north.

Engines with trains	3,778	
Engines without trains	126	
Total engines		3,904
Passenger-cars		5,415
Freight-cars		62,120
Foot-passengers		189,476
Teams		126,031
Steamboats		896
Barges		271

Passing south.

Engines with trains	3,662	
Engines without trains	237	
Total engines		3,899
Passenger-cars		5,433
Freight-cars		61,765
Foot-passengers		192,931
Teams		126,516
Steamboats		884
Barges		255
Rafts		551

MOLINE BRIDGE.

The Moline bridge has been thoroughly painted with two coats of lead paint during the year.

ORDNANCE AND ORDNANCE STORES.

The receipt of the large amount of stores shipped from the Saint Louis arsenal to this arsenal, all of which has been thoroughly overhauled, assorted, and stored, and the unusually large issues to the Army, caused by Indian troubles involving a great deal of cleaning and repairing to make stores fit for issue, has involved a large amount of work under the above head.

* * * * * * *

Respectfully submitted.

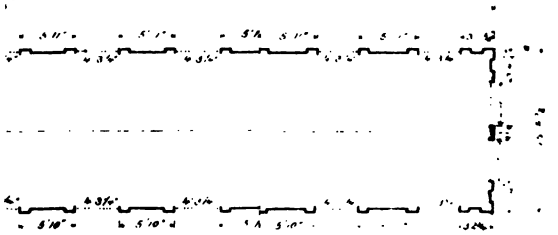
D. W. FLAGLER,
Major of Ordnance, Bvt. Lieut. Col., U. S. A., Commanding.

ROCK ISLAND ARSENAL, ILLINOIS,
August 4, 1877.

A.

k Island Arsenal,
Febr 17 1877

D. W. FLAGLER,
ior of Ordnance,
Lieut Col U.S.A.
Comnd'g



anying Major Flagler's History of Rock Island
Appendix No 1877

their entrance into the copper. It was found that a No. 15 thread allowed the groove to be of the depth required, and still left the edge strong enough to meet considerable pressure when its cross-section was regulated to resist by its bracing form the outward pushing of the copper. This thread was accordingly adopted for cutters, which are of uniform diameter throughout.*

For the special purpose for which they were designed the housings were modified as shown herewith.

The rearmost piece of the housing has a dovetail-cut made in it to receive a correspondingly-shaped tenon on the forward end of bolt B, Fig. 11.

On the rear end of this bolt a plus screw thread is cut. The breech of the gun being bored out to the proper depth from the rear, and counter-bored and tapped, the housing is to be slipped on to the tenon of the bolt. This is then inserted and screwed home by means of the handle in rear. When in position the face of the housing lies about 1 inch from the bottom of the bore of the gun. A copper washer between the face of the housing and the bottom of the counter-bore prevents the escape of gas. Similar washers in the housing replace the rubber ones before used. This housing is also available as an internal-pressure gauge. The dovetail in the breech-screw in this case holds a clamp (Fig. 12) intended to prevent the loss of the plunger, which, without this precaution, is sometimes jarred out in the discharge. A wire placed as shown (Fig. 23) had proved insufficient for the purpose.

This is the instrument used in the competitive experiments, an account of which is given herewith.

When the gun is fitted with the usual external Rodman housings, this gauge may be used with it by placing on the outer extremity of the Rodman piston a shallow cup to hold it, and by bringing down the bearing-screw upon the end of the small piston, as shown herewith, (Fig. 13.) This arrangement allows it to be substituted for the Rodman cutter, in comparative experiments, in exactly the same position as the latter. A variation of this plan was tried in which the spiral cutter and the copper were slipped into the bore of the Rodman housing. It was tried singly and in combination with the Rodman cutter, but in neither case was found to work well.

The large pressure-gauge prepared for Fort Monroe arsenal is essentially on the same plan as that last described.

In order to increase the size of the copper without correspondingly augmenting the area exposed to the blast, the piston is made in the form shown in Fig. 14. The size of the portion in which the spiral is cut not being limited, as in the former case, the thread can be much coarser, and, on account of its greater strength, can be divided radially into tenths.

THE PROTRACTOR.

In the first plungers made the spiral was divided into eighths by notches cut with an index milling-machine. As the cutter descended into the copper these notches left corresponding ribs in the spiral cut, by counting which its extent could be estimated. It was found in practice that these notches would afford initial points for fractures to occur, and their use was discontinued except for the very large gauges made for Fort Monroe.

To provide a more exact means for measuring this cut the protractor

* The extreme length of this thread is 1″.15, equal to that of a Rodman cutter of ordinary size.

was designed. It consists of the circular brass plate A, the edge of which is divided into degrees of circular arc, and in the center of which is a hole just large enough to receive the copper disk. There is also the diametrical arm B, so formed as to embrace the edge of the plate freely by means of an under-cut lip at each end. Beneath the hole in the plate is a button to keep the disk from falling out.

To use the protractor the arm is set at 0°, the disk is then set by hand from beneath the plate, so that the large end of the cut shall be just concealed beneath the edge of the arm. The arm is then swung to the other end of the cut, and the reading taken.

DESCRIPTION OF THE CUTTERS USED IN THE SPIRAL PRESSURE-GAUGE.

No. 1. A No. 26 thread on a cone 0″.08 long, diameter = 0″.357. The edge of the cutter notched radially into eighths; length of total edge = 2″.6.

No. 2. A No. 15 thread on a cone, as in No. 1, the edge notched in tenths; broke at 4,500 pounds pressure.

No. 3. Like No. 2; broke at 5,000 pounds, thrice repeated.

No. 4. Same as No. 2; broke at 5,000 pounds.

No. 5. Same as No. 2, but without notches; dependence being had on the protractor for measuring the extent of the cut. Lost.*

It was found that the little notches cut in the edges of the spiral served, however slight they might be, to determine points for the fracture whenever it occurred. They were consequently left out in all the small cutters after No. 4.

No. 6. A No. 6 thread on the same cone heretofore used—no notches. This was designed to give one turn only in the size of the piston, and thus to avoid the swaging of the copper between the concentric spirals.

No. 7. Same as No. 6, except, having been made from a smaller forging, the scroll was not as perfect as in No. 6.

Nos. 8 and 10, (Fig. 18.) No. 10 thread on a cone 0″.1 long and 0″.75 diameter. These cutters were so large that it was thought they would stand notching; they were consequently marked off in tenths.†

Nos. 9 and 11, (Fig. 19.) 6.8 thread. Other particulars as in Nos. 8 and 10. No. 11 was left large before hardening. No. 9 broke, as did No. 8, both being made at the same time.

Nos. 12 and 13. No. 15 thread. Cone, &c., as in No. 5. These were made from "Crescent" special steel. (Ely & Williams, Philadelphia.)

In the course of my experiments I have also used the Rodman external and internal housings, as described in General Rodman's report above referred to; also, an external housing on his plan for use with the musket-barrel, (Fig. 21,) and a crusher-gauge on the English plan, (Fig. 22,) kindly lent me by Colonel Laidley, Ordnance Department. The Rodman external housing for the musket (Fig. 11) is screwed on a 0″.50 caliber musket-barrel, in which a rim-fire cartridge with a perforated head can be exploded by a firing-pin passing obliquely through the housing.

* Nos. 2, 3, 4, 5, were cut with a tool making the outside surface of the edge more or less straight, as shown in the somewhat exaggerated sketch herewith, (Fig. 15.) The tendency of this form was to allow the flow of copper to force the teeth outward under heavy pressures, and thus to break them off, (Fig. 16.) In subsequent cutters this has been corrected by making the teeth of the chasing-tool more bracing on the outside, (Fig. 17.)

† No. 8 having been hardened at about the finished size, a piece chipped off from one of the outer spirals; not enough, however, to impair its efficiency for ordinary work. No. 10 was left large before hardening.

THE CRUSHER-GAUGE—Fig. 22.

This consists of a gas-check, A; a plunger, B; an annealed copper cylinder, C; the body D; the bottom screw E, between which and the body is a copper washer, F. The copper cylinder is kept central by being loosely wrapped with a soft string of some kind, such as the raveling of flannel, &c.

The body is notched, as represented, for a crutch-wrench. This gauge may be used externally in the manner described for the spiral gauge. (See page 415.)

EXPERIMENTS.

The following firings were executed for the sake of comparing the three systems under conditions as nearly alike as possible. For this purpose a 3″ rifle was used, that being the only disposable gun at this post. This gun was tapped to receive two external housings, in the same plane of cross-section through the seat of the charge. The charge was uniformly 1 pound Hazard's mortar-powder, with a cast-iron slug having an ogival point, and weighing from 10 pounds to 10¼ pounds. The windage was $\frac{1}{40}$ the caliber, or = 0″.075.

For convenience of reference, where so many cutters were used, they are referred to as follows:

NOMENCLATURE.

Rodman.

Externally—regular cannon-cutter with disks made at Springfield.	A
musket-cutter, with same disks as A	B
Fort Monroe cutter belonging to internal-pressure gauge from that post, with the copper disks belonging to it	C
Internally—Same, with its own disks	D

Spiral.

Externally—cutter No. 4 in housing No. 1	E
cutter No. 5 in housing No. 2	F
cutter No. 6 in housing No. 2	G
Internally—cutter No. 10, (large)	H
cutter No. 11, (large)	I
cutter No. 4 in housing No. 1	J
cutter No. 5 in housing No. 2	K
cutter No. 6 in housing No. 1 or No. 2	L

Crusher.

Externally	M
Internally	N

Although the following programme could not be fully carried out, it is still inserted, as it gives a general idea of the object of the experiments:

PROGRAMME.

I.

No. of fire.	Gauges.	Remarks.
1	A, B, D, N.	Comparing the three Rodmans with each other, introducing the crusher as a connecting link with the next experiment.
2	Same.	
3	Same.	

II.

4 5 6	E, F, H, N. Same. Same.	As in I, substituting the spiral gauges for the Rodman.

III.

7 8 9	A, E, H, K, N. Same. Same.	Comparing the two varieties of internal spiral gauges with each other, with the external spiral and with the external Rodman, at the same fire—crusher as before.

IV.

10 11 12	C, M, I, J, L. Same. Same.	Comparing the Fort Monroe cutter and the crusher, externally used, with their previous readings *within* the gun; also, the coarse spirals with the finer ones.

TABLE No. I.—*Record.*

Fire.	Letter.	Gauge.	Cut, &c.	Pressure per square inch.	Remarks.
1	A	Rodman external	0.92	23,000	
	B	Rodman external	0.84	22,000	
	D	Rodman internal, Fort Monroe	1″.36	118,000	
	N	Crusher internal	0″.32	21,000	
2	A	Rodman external	0.93	23,500	
	B	Rodman external	0.87	24,000	
	D	Rodman internal, Fort Monroe	±1″.45	±155,000	Exceeded diameter of disk.
	N	Crusher internal	0.31	23,500	
3	A	Rodman external	0″.90	22,000	
	B	Rodman external	0″.75	17,500	
	D	Rodman internal, Fort Monroe	1″.30	102,000	
	N	Crusher internal	0″.32	21,000	
4	E	Spiral external	510°	20,000	
	F	Spiral external	540°	23,000	
	H	Spiral internal	430°	21,000	
	N	Crusher internal	0″.33	18,000	
5	E	Spiral external	605°	30,000	
	F	Spiral external	555°	25,000	
	H	Spiral internal	470°	24,500	
	N	Crusher internal	0″.31	23,500	
6	E	Spiral external	530°	23,000	
	F	Spiral external	575°	26,000	
	H	Spiral internal	490°	26,000	
	N	Crusher internal	0″.32	21,000	
7	A	Rodman external	0″.87	20,500	
	E	Spiral external	510°	21,500	
	H	Spiral internal, large	435°	21,000	
	K	Spiral internal, small	465°	16,500	
	N	Crusher	0″.32	20,000	In "K," above, a stout wire was passed through the eye of the plunger and fastened at the other end of the housing to keep the plunger from jarring out. This may have interfered with the descent of the plunger, Fig. 23.
8	A	Rodman external	0″.94	24,000	
	E	Spiral external	510°	21,500	
	H	Spiral internal, large	590°	37,000	
	K	Spiral internal, small, (lost)	570°	26,000	"K" was fastened as before, but with the wire disposed so as not to interfere with the descent of the plunger. Notwithstanding this the plunger was lost.
	N	Crusher	0″.32	20,000	
9	A	Rodman external	0″.87	20,500	
	E	Spiral external	570°	26,500	
	H	Spiral internal, large	570°	35,000	
	L	Spiral internal, small, (No. 6, coarse.)	250°	17,000	"L," the housing, was broken at the intersection of the clamp. The clamp was also bent so as to make it unserviceable, supposed to arise from the ballotting together of the various gauges.
	N	Crusher	0″.32	20,000	
10	C	Rodman external, Fort Monroe	0″.36	8,000	
	M	Crusher external	0″.32	21,000	
	I	Spiral internal, large	265°	23,000	
	J	Spiral internal, small	465°	18,000	

TABLE NO. I.—*Record*—Continued.

Fire.	Letter.	Gauge.	Cut, &c.	Pressure per square inch.	Remarks.
	K	Spiral internal, small	490°	18,000	At this point it was decided that so many gauges used at once probably interfered with one another, and that henceforth but one internal gauge would be used at each fire.
11	C	As above	0″.58	21,500	
	M	As above	0″.31	23,000	
	I	As above	255°	21,500	
12	C	As above	0″.89	50,000	
	E	Spiral external	810°	49,000	
	L	Spiral internal	260°	19,000	
13	C	As above	0″.78	39,000	
	L	Spiral internal	280°	23,000	
14	C	As above	0″.85	46,900	
	G	Spiral external	360°+	50,000+	
15	A	Rodman external	1″.09	32,000	
	M	Crusher external	0″.26	35,000	
16	A	As above	0″.96	25,000	
	D	Rodman internal, tied in 2″ from bottom of cartridge-bag.	1″.35	120,000	In this case the cartridge-bag was tied into the housing far enough from the bottom to make sure of the latter resting against the bottom of the bore.
	L	Spiral internal	300°	28,000	
17	A	Rodman external	1″.15	36,000	It had been suggested by Lieutenant Butler, Ordnance Department, that the abnormal pressures of "D" might have arisen from the shock of the gauge against the bottom of the bore when the piece was fired, the bellying out of the charge having prevented the gauge from resting solidly against the bottom of the bore.
	G	Spiral external	350°	50,000+	The object of this fire and the succeeding one was to determine whether the presence of the large spiral internal housing alone affects the pressure in a manner at all corresponding to that of the Rodman internal. (*Vide* fires 1, 2, 3, &c.)
18	A	Rodman external	0″.90	22,000	
	B	Rodman external	0″.72	16,500	
	H	Spiral internal, large	440°	21,500	
19	A	Rodman external	1″.12	34,000	
	M	Crusher external	0″.26	35,000	
20	A	Rodman external	1″.14	35,000	
	B	Rodman external	1″.10	42,000	
	N	Crusher internal	0″.295	22,000	
21	A	Rodman external	0″.96	25,000	
	D	Rodman internal	1″.4+	±150,000	
22	D	Rodman internal	1″.15	82,000	For this fire the bottom of the housing was turned out square and true, (see Figs. 2, 4, 6.) Before this, as was found by taking a cast of the housing, the corner was filled and the middle of the disk unsupported; this tended to let the cutter down into the copper more easily than it should, and thereby to extend the cut unduly. (Fig. 24 a.)

The following table (No. II) allows of a somewhat more ready comparison of the results of these firings. In order to facilitate this comparison, only the initial figures of the thousands of pounds are given. Thus 23 represents a pressure of 23,000 pounds per square inch.

The influence of large internal gauges in reducing the pressure was so plainly marked that the results of firing with and without these large gauges are given separately. It will be seen that the absence of the large gauge in this caliber ran up the pressure on an average from 22,000 to 37,000 pounds. The want of consistency in these results is bewildering, and renders difficult any really definite comparisons. There are a few data, however, which may be derived from considering them:

First. The pressures indicated by the internal Rodman gauge are so very much greater than those represented by any other plan that they

may safely be disregarded, as occasioned by the use of an instrument unsuited to the caliber of the gun.*

Second. The external gauges, as a rule, give higher records than do the internal gauges of the same kind.

Third. The presence of a large internal gauge diminishes the indicated pressures of other gauges simultaneously applied.

Fourth. Only one internal gauge should be used at the same fire, otherwise the gauges are subject to injury from balloting against each other in the bore of the gun.

COMPARISONS.

It will be seen that the spiral gauge in the external housing gives as high pressures as the Rodman cutter similarly placed. This would indicate that the trouble formerly found in its want of response to these high pressures has been overcome.

The crusher does not run up quite so high, though this may perhaps result from lack of opportunity. It would seem, however, that the great change of form of the copper cylinder which these high pressures demand would not be as easily and quickly effected as the cut caused by the entrance of the straight or spiral edge. A clearer view of the subject would probably be attained by further firings, conducted in the light of these experiments and of those for which the apparatus described on pages 362 and 363 (Fig. 11) is designed.

There being no piece at this post of large caliber conveniently placed for such experiments, I would recommend that they be made at whatever post may be selected for the purpose, with a gun of at least 8″ caliber, and that with these experiments be combined the determining of the velocities of the projectiles as a check upon the other results.

NOTE.—By experiments made with the testing machine at this armory, and at Colt's works, Hartford, Conn., it is shown that when the pressure is *absolutely* the same the results with the spiral gauge are more uniform than those with the Rodman. If, therefore, its results are more uniform, and are as easily attainable in the gun, it would appear the better gauge. The cause of this, in my opinion, is probably due to the size of the Rodman disks, the hardness of which, as shown by experiment, may vary materially within the same disk, not to speak of the variations between different disks.

*This objection is in part overcome by the means described above, (see fire No. 22.)

TABLE No. II.

[Initial figures of thousands of pounds pressure only are used, *e. g.*, 16.5 = 16,500 pounds pressure per square inch. The columns where no large internal gauge (D, H, I) was used are headed 0; when a gauge was used internally the column is headed ×.]

		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	No. of shots.	Average.	Highest.	Lowest.	Taken from fires where no large internal gauge was used.			Taken from fires where large internal gauges (D, H, I) were used.		
																											Average.	Highest.	Lowest.	Average.	Highest.	Lowest.
		×	×	×	×	×	×	×	×	×	×	×	0	0	0	0	0	0	×	0	0	0										
Rodman external ..	A	23	23	22	....	....	..	20.5	24	20.5	....	....	....	....	....	32	25	36	22	34	35	25	13	26.0	36.0	20.5	34.0	36.0	32.0	24.0	25.0	20.5
Rodman external ..	B	22	24	17.5	....	....	..	....	....	....	....	....	....	....	....	....	....	....	16.5	....	42	....	5	24.5	42.0	16.5	42.0	....	....	20.0	24.0	16.5
Rodman external ..	C	....	....	....	....	....	....	....	....	....	8	21.5	50	39	46	....	....	....	....	....	....	....	5	33.0	50.0	8.0	45.0	50.0	39.0	15.0	21.5	8.0
Rodman internal..	D	118	155	102	....	....	....	....	....	....	....	....	....	....	....	....	120	....	....	....	....	165+	5	130.0	165.0	102.0	.....	.....	.....	.....	.....	.....
Spiral external, (4)	E	....	....	....	20	30	23	21.5	21.5	26.5	....	....	49	....	....	....	....	....	....	....	....	....	7	27.0	49.0	20.0	49.0	.....	.....	24.0	30.0	20.0
Spiral internal, (4)	J	....	....	....	....	....	....	....	....	....	18	....	....	....	....	....	....	....	....	....	....	....	1	18.0	18.0	18.0	.....	.....	.....	18.0	.....	.....
Spiral external, (5)	F	..	....	....	23	25	26	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	25.0	26.0	23.0	.....	.....	.....	25.0	26.0	23.0
Spiral internal, (5)	K	....	....	....	....	....	..	*16.5	26	....	....	....	....	....	....	....	....	....	....	....	....	....	3	20.0	26.0	16.5	.....	.....	.....	20.0	26.0	18.0
Spiral external, (6)	G	....	....	....	....	....	..	....	....	....	....	....	....	....	50	....	....	50	....	....	....	....	2	50.0	50.0	50.0	50.0	.....	.....	.....	.....	.....
Spiral internal, (6)	L	....	....	....	....	....	....	....	....	*17	....	....	19	23	....	....	28	....	....	....	....	....	4	22.0	28.0	17.0	21.0	23.0	19.0	22.0	28.0	17.0
Spiral internal, (10)	H	....	....	....	21	24.5	26	21	37	35	....	....	....	....	....	....	....	....	21.5	....	....	....	7	27.0	37.0	21.0	.....	.....	.....	24.0	37.0	21.0
Spiral internal, (10)	I	....	....	....	....	....	....	....	....	....	23	21.5	....	....	....	....	....	....	....	....	....	....	2	22.0	23.0	21.5	.....	.....	.....	22.0	23.0	21.5
Crusher external...	M	....	....	....	....	....	....	....	....	....	21	23	....	....	....	35	....	....	....	35	....	....	4	28.5	35.0	21.0	35.0	35.0	35.0	22.4	23.0	21.0
Crusher internal ...	N	21	23.5	21	18	23.5	21	20	20	20	....	....	....	....	....	....	....	....	....	....	22	....	10	21.0	23.5	18.0	22.0	.....	.....	21.0	23.5	18.0
Average																											37.0	.....	.....	21.0	.....	.....

* Note page 367.

RESULTS OF ABOVE TABLE ARRANGED IN DECREASING ORDER.

× indicates the simultaneous use of one of the large internal gauges, (D, H, I;) 0 indicates their absence.

RODMAN EXTERNAL GAUGES.													
A	0 36	0 34	0 34	0 32	0 25	0 25	× 24	× 23.5	× 23	× 22	× 22	× 20.5	× 20.5
B	0 42	× 24	× 22	× 17.5	× 16.5								
C	0 50	0 46	0 39	× 21.5	× 8								
SPIRAL.													
E	0 49	× 30	× 26.5	× 23	× 21.5	× 21.5	× 20						
F	× 26	× 25	× 23										
G	0 50	0 50											
CRUSHER.													
M	0 35	0 35	× 23	0 21									

RODMAN INTERNAL GAUGES.													
D	165	155	120	108	102	Large gauge.							
SPIRAL.													
J	× 18												
K	× 26	× 18	× 16.5*										
L	0 28	0 23	0 19	× 17*									
H & I	37	35	26	24.5	23	21.5	21 5	21	Large gauges.				
CRUSHER.													
N	× 23.5	× 23.5	0 22	× 21	× 21	× 21	× 20	× 20	× 20	× 18			

* See note page 367.

APPENDIX.

The following notes are transcribed from the daily Experiment Book of this office:

Two other forms of cutters beside the conical were employed. One (Fig. 1) had the spiral edge cut on a concave surface. This was especially designed for high pressures, but was found weak.

Another form (Fig. 2) was designed for low pressures, so as to give an extended cut for a relatively low pressure. The thread was cut on a convex spherical surface.

Neither of these forms was found to offer any advantages in compensation for the trouble involved in making and using them.

The necessity for a close fit of the copper disk is shown by the following experiment, (Fig. 26:)

0 thickness of paper at A gave..... 630°
1 thickness of paper at A gave..... 655°
2 thicknesses of paper at A gave..... 665°
3 thicknesses of paper at A gave..... 790°

The following is an extract from the record of some experiments with the Richards testing-machine, at Hartford. This machine is constructed to weigh pressures up to 100,000 pounds. Its beam, when balanced at 20,000 pounds, has been turned by the addition at straining point of $\frac{1}{4}$ pound.

TABLE No. III.—*Spiral cutter No. 4, in housing No. 1.*

Weight.	Reading.			Average.	Extreme variation.	= pounds per square inch.
Pounds.	*Inches.*			°	°	*Pounds.*
500	245	245	245	245	.....	.....
1,000	370	360	375	368	15	750
1,500	430	430	430	433	.....	.....
2,000	490	480	480	488	10	960
2,500	535	535	535	535	.....	.....
3,000	610	600	610	607	10	780
3,500	665	660	665	666	5	440
4,000	720	720	720	720	.....	.....
	Extra.					
2,500	535	540	535	540	540	.....	.....	.....

TABLE No. IV.—*Richards testing-machine—Crusher gauge, with copper cylinder—0″.375 long by 0″.25 diameter.*

Weight.	Measurement.	Change.
Pounds.	*Inches.*	*Inches.*
500	0.372	0.003
1,000	0.360	0.015
1,500	0.342	0.033
2,000	0.323	0.052
2,500	0.305	0.070
3,000	0.286	0.089
3,500	0.260	0.115
4,000	0.239; 0.238	0.137
4,500	0.223	0.152
5,000	0.203	0.172
5,500	0.191	0.184
6,000	0.178	0.197
6,500	0.173	0.202
7,000	0.171	0.204

TABLE No. V.—*Springfield testing-machine, (originally constructed for the hydraulic proof of gun-barrels.)*

Weight.	Rodman internal, C.	Spiral No. 5 in housing No. 2.	Spiral No. 6 in housing No. 2.	Spiral No. 10.	Spiral No. 11.	In Hartford machine.	
						Spiral No. 12.	Spiral No. 13.
Pounds.	*Inches.*	°	°	°	°		
250	.....	.....	120	140	110	.....	.....
500	.....	220	160	230	150	295	308
1,000	0.40	390	215	300	180	420	430
1,500	0.49	445	240	370	225	570	570
2,000	0.51	515	260	425	252	593	573
2,500	.....	560	290	480	283	645	635
3,000	0.68	610	303	535	311	677	698
3,500	.....	650	310*	570	343	.....	.....
4,000	4,200 = 0.81	710	320*	615	365	.....	.....
4,500	.....	.....		637	390	.....	.....
5,000	0.86	.....	* Limit.	675	420	.....	.....
5,500	0.95	.....	.....	695	450	.....	.....
6,000	.....	.....	.....	725	470	.....	.....
7,000	1.05	.....	.....	777	505	.....	.....
8,000	.....	.....	.....	825	515	.....	.....
9,000	.....	.....	.....	860	525	.....	.....
9,500	1.24 1.23 1.26	.....	.....	.....	.....	.....	.....

The following charts were prepared from these experiments:

Exceedingly erratic indications are disregarded in marking out the general course of the curve.

It will be noticed that the variations are much greater with the Rodman gauge than with the spiral gauge or crusher, and that the impressions from the Rodman cutters agree neither in extent nor in uniformity with those recorded in General Rodman's report. It is difficult to account for this, as the copper disks were all prepared and used with great care. The necessary uniformity of the testing-machine precludes the idea of attributing these variations to the causes which obtain in powder pressures.

Very respectfully, your obedient servant,

HENRY METCALFE,
Lieutenant of Ordnance.

Major J. G. BENTON,
Commanding.

[First indorsement.]

NATIONAL ARMORY, *March* 5, 1874.

Respectfully forwarded to the Chief of Ordnance.

J. G. BENTON,
Major of Ordnance, Commanding.

B.—*The Benton Dynamometer.*

NATIONAL ARMORY,
Springfield, Mass., March 21, 1877.

SIR: For the information of the Department, I inclose herewith a report by Lieutenant Lyle on the dynamometer made at this armory for the use of the Military Academy.

In addition to determining the pressure in copper specimens it is used at this armory for obtaining the tensile strength of the materials used in small-arms.

Respectfully, your obedient servant,

J. G. BENTON,
Lieutenant-Colonel, Commanding.

The CHIEF OF ORDNANCE, U. S. ARMY,
Washington, D. C.

THE BENTON DYNAMOMETER.

This instrument invented by Lieut. Col. James G. Benton, Ordnance Department, United States Army, is designed to be used in connection with the Rodman pressure-gauge, for the purpose of determining the pressure per square inch exerted within the bores of cannon and small-arms by the ignition of powder. It may also be used for testing the tensile strength of materials or for measuring their compression within certain limits. The size of the specimens would necessarily have to be small.

When used for either of the latter purposes, special forms of housings have to be made to fit between the guide-blocks. In testing for tensile strength, provision must be made to check the sudden reaction of the springs at the instant of rupture, by interposing a block of rubber, or some other yielding substance, in order to break the force of recoil.

DESCRIPTION.

This machine consists essentially of—

1. The frame.
2. The springs.
3. The cylindrical casing.
4. The guide-blocks.
5. The screw.
6. The graduated scale.

The frame is rectangular in form and made of cast iron. It rests upon a wooden pedestal formed of two thick cheek-pieces into which a transverse piece of timber is mortised and securely held by two long wrought-iron bolts.

The frame is fastened to this pedestal by four bolts, also of wrought iron.

The steel springs are comprised in two systems, or nests, of concentric spiral springs, consisting of three springs each. The outer is a left-handed spiral and has the greatest cross section; the middle one is a right-handed, and the central a left-handed, spiral. The two systems are placed one above the other between the uprights of the cast-iron frame, with a thin steel plate between them. The cross-sections of all the springs are rectangular, that of the central ones being the least. They are inclosed by a hollow cast-iron cylindrical casing, concentric with, but not touching them. This casing does not rise to the level of the nests by nearly three inches, to allow space for their compression.

The lower guide-block has on its under surface a flat disk of iron with a diameter equal to the exterior diameter of the springs, which rests upon the upper base, in order to give a good bearing surface. These nests of springs are those used for the ordinary car-buffers, with the exterior and interior cylindrical surfaces turned smooth, so that the springs of each system are concentric without being in contact. Each nest is 7″.68 in length, measured on the axis.

The lateral deflection of the axis of the entire system due to compression is obviated by using two systems, or nests, as described above, with a steel disk between them, and by grinding the limiting bases of the springs to plane surfaces perpendicular to their axes, and inserting small steel blocks under the tapering terminal ends of the spirals, thus insuring the rigidity and stability of position of the basal planes of each system of springs.

This blocking up and squaring the ends, while diminishing the amount

of their compressibility, allow the power applied to the screw to be transmitted more uniformly to the springs, as they come to a bearing almost simultaneously.

The guide-blocks are two rectangular pieces of cast iron, with planed surfaces, accurately fitted to move between the planed surfaces of the uprights of the frame. In front they are confined to their positions by steel side plates screwed to them, and projecting shoulders retain them on the rear side of the frame. The lower block rests on the upper set of springs, and carries a cylindrical cap of nickel-plated brass, which conceals that portion of the springs which projects above the cylindrical casing.

This cap is slotted at the sides to allow it to slide up and down the frame. Its diameter is a little greater than that of the casing, to admit of its passing over the latter during compression. The upper guide-block is attached to the screw by a shoulder which turns easily in a recess in the surface of the block, and is covered by a steel plate let into its upper side flush with the surface, and held by six screws.

The screw is of steel, 1″.6 in diameter, with eight (8) threads to the inch; it engages a female screw in the upper cross-piece of the frame. The motion of the screw is limited in the direction of the axis by a metallic collar attached to the newel just below the wheel. The power is applied to a cast-iron wheel attached to the upper end of the screw. The length of the screw and the position of the collar are so correlated that, when the machine is not in use, should the screw, by accident or design, be depressed to its fullest extent, no initial tension can be brought to bear upon the springs, provided the housing and block have been removed from between the guide-blocks, as they invariably should be except when in legitimate use.

A graduated scale 6″ long, made of a small square steel bar, is attached to the frame by two small blocks. These blocks are slotted to receive the ends of the scale. A screw inserted through each block and into the ends of the scale-bar furnishes the means of a longitudinal adjustment.

A small sliding-block upon the scale, whose upper plane surface serves as a pointer, has a toe projecting from one side to receive the pressure of the lower edge of the side plate of the lower guide-block during its descent. This index or pointer is held in any position on the scale by the action of a gib, whose pressure is regulated by adjusting screws. The scale upon its four sides is graduated into 16ths, 50ths, 64ths, and 100ths of an inch, respectively.

APPENDAGES.

When the dynamometer is used for finding pressures, the appendages are—

1. The block.
2. The housing.
3. The copper block or disk.
4. The cutter.
5. The limit-gauge.

The block is of cast iron, planed and fitted by narrow overhanging lips to the upper surface of the upper guide-block. A pin projecting from the latter into a small hole countersunk in the bottom of the block centers it, and a corresponding pin set in its upper surface performs the same function for the housing, thus insuring the coincidence of the line of direction of the pressure with the axis of the screw. The

housing is made of tempered steel, and its form and dimensions must conform to the object in view. The one used in the experiments made here was of the form shown in Figs. 3, 4, Plate II.

The side screws (two on each side) project internally far enough to bring the edge of the cutter, when in position, upon a line one-third of the width of the copper block from its longer side.

By shifting the copper block, a second cut may be made in the same block. The widths of metal between the cuts and edges will be equal. The side screws serve to adjust the copper blocks in the housing and offer no serious obstruction to the flow of the metal, the places of contact being mere points.

The position of the cutter is invariable, laterally. There is a stop on the back of the housing to facilitate the longitudinal adjustment of the copper block and cutter. The blocks were cut from bars of copper, from 4′ to 8′ long, .″75 wide, and .″45 thick, which were prepared expressly for this purpose by James G. Moffet, No. 119 Prince street, New York. The metal has a specific gravity of 8.808, and is intended to be as pure and homogeneous as possible. The blocks were all carefully planed, as nearly as practicable, to the same size. Their approximate dimensions were, length 1.″205, width .″708, and the thickness .″435. Their average weight was about 830 grains, with extremes of 821.5 grains and 837 grains. The cutter used was one devised and made by Mr. J. S. Adams, a workman in the National Armory, in June or July, 1875, to be used with the Rodman pressure-piston and housing. The cutter block is of tempered steel and is rectangular in shape.

The cutting or *indenting* edge is an arc of a circle; the two surfaces whose intersections form the edge are two right cones with circular bases. The form and dimensions are shown in Figs. 5, 6, Pl. II.

The limit-gauge is shown in Figs. 7, 8, Pl. II. It consists of two parts. The lower part has on its upper end a screw which fits into a corresponding female screw upon the interior cylindrical surface of the upper part. This arrangement gives a longitudinal motion by which the length of the gauge can be adjusted. The planes of the ends of the gauge are parallel to each other. A collar on the upper part, and the base on the lower, are either milled or checked, for ease of turning while adjusting.

ADJUSTMENTS.

The instrument should be mounted upon a solid foundation and the iron frame securely bolted to the wooden pedestal. Put the cylindrical casing in the frame and place the large spiral spring of the bottom nest in position, concentric with the casing, so as not to be in contact with it. This may be determined by moving the thin strips of wood which are placed vertically around the outside of the spring. If they bind, move the spiral slightly.

Put in the other two springs, (the larger first,) taking care not to displace the first spring. See that they are concentric with it and that the ends of the spirals break joints. Next lower the steel disk upon the springs and adjust the upper nest in the same careful manner. The axes of the two nests of springs and the casing should now be coincident. Put the guide-blocks, nickel-plated cap, screw, wheel, and graduated scale in position. Adjust the scale by the longitudinal screws until it is engaged .″12 (in order to use appended tables) in the upper slot. Use the side of the scale having fifty (50) divisions to one inch; it is more easily read, and hundredths of an inch can be readily estimated when the index falls between the divisions.

METHOD OF USING.

To obtain the pressure per square inch exerted within the bore of a gun, use the cutter, housing, and copper block as prescribed for the Rodman pressure-gauge, and then remove them to the Benton dynamometer. First place the block on which the housing rests in position upon the lower guide-block, put the housing on this block, and replace the copper block and cutter (with the piston removed) in the same relative position in the housing as when the piece was fired. The cutter must rest in the indentation, or cut, already made in the copper. Lower the screw until the upper guide-block rests upon the cutter-block and brings the cutter to a bearing; then adjust the limit-gauge until it will barely slide without binding between the plane surfaces of the upper guide-block and the block under the housing. Next elevate the screw a little, raise the cutter slightly from the cut, and slip the copper block to the other side of the housing, noting that its edge touches the side screws on that side. Now lower the cutter until it rests lightly upon the upper surface of the copper, and gradually bringing the screw to a bearing; then turn it down as uniformly as possible until the upper guide-block approaches the top of the limit-gauge, and move slowly until the gauge will barely slide backward and forward, as in the first case. Read the scale on the instrument and look in the table for the pressure corresponding to this reading. In this case the two cuts are upon the same block of copper, which obviates any difference in density that might exist when separate blocks are used. For pressures varying from 5,000 pounds to about 34,000 pounds per square inch, there appears to be no difference in the lengths of the two cuts made in the same block for the same reading of the scale. For pressures between 34,000 and 54,000 pounds per square inch there was a variation in the lengths of the cuts from .″005 to .″04, the indentation first made being in every case the longer. This is probably due to the compression caused by the first cut increasing the density of the contiguous particles and offering a greater resistance to the cutter in the second case.

The length of cut should be expected to be less in the latter case for the same pressure.

EXPERIMENTS.

These were undertaken to determine the weights necessary to compress the compound system of springs through given linear distances. It was assumed that within certain limits the resistance of the springs would vary directly with the degree of compression. The object of the experiments was to determine the resistance of the springs when compressed through the distance unity. The linear unit of distance was assumed to be one-tenth (0″.1) of an inch.

The graduated scale was engaged 0″.12 in the upper slot when the readings were made, and remained so throughout the experiments. All readings given are estimated from the zero (*i. e.*, upper face or end of graduated bar) of the scale.

The instrument was mounted on the second floor of a building; the wheel, screw, guide-blocks, and casing removed.

Holes were bored through the floor and transverse bar of the wooden pedestal, and on the prolongation of the common axis of the springs. An iron rod passed up through the floor, bar, springs, and an iron disk resting on them. This rod was secured above by a nut and washer, and from its lower extremity was suspended a large wooden platform by

strong ropes. The weight of the rod, nut, washer, disk, ropes, and platform was 200 pounds.

This weight was kept constant during the experiments. Masses of lead, of such sizes and weights as could be handled by one man, were then carefully weighed upon Fairbanks's scales, transferred gently to the suspended platform, and the reading of the scale taken. Then another lot of weights were added and a second reading taken. The weights added at each time were just sufficient to depress the springs one-tenth (0″.1) of an inch.

The first series of experiments displayed a certain want of harmony between the results, which could only result from some irregular and abnormal cause. It was thought that some of the springs were in contact. They were examined, adjusted, and cylinders of fine white paper were placed between the springs of each nest to see if they rubbed. After several trials the paper cylinders were removed, but exhibited no indications of either rubbing or contact; still the abnormal variation continued. Upon further search for the perturbating cause, it was discovered that the iron suspending rod was bearing strongly against the cylindrical surfaces of the holes bored through the floor and transverse block, thereby developing a variable force of friction due to the roughness of the surfaces of contact and the want of lubrication.

It was also found that the assistants, in putting on the weights, had, in the case of the heaviest weights, dropped them on the platform, instead on laying them on gently. These extraneous defects were remedied and no further trouble was experienced.

At the end of the second series of experiments, a weight of 6193.5 pounds was left upon the springs for 19 hours and 30 minutes to find what the effect would be upon them. The "set" of the springs was found to be .″07, which was but temporary, as they afterward rose to their initial reading.

RESULTS.

I. It was found that the initial reading (when presure = 0) of the scale was nearly constant. (*Vide* columns 5 and 6, Table I.)

II. That there was no uniformity in the weights required to compress the system of springs until the reading on the scale was 1″.1, from which point the force required to compress the springs through equal spaces presented great uniformity between certain limits. This was probably due to the fact that before that reading was attained the springs had not all come to a proper bearing. It was found that 500 pounds was a very close approximation to the force required to compress the springs to that limit, (1″.1.) That force (500 pounds) has accordingly been assumed as the one necessary to produce the compression indicated by 1″.1 upon the scale, provided the initial tension upon the springs, when not in use, be zero.

III.—*First case.* That between the limits 1″.1 and 2″.0 upon the scale, the force required to compress the springs one-tenth (0″.1) of an inch was $=x=270.17$ pounds, with a probable error of $\pm 0.1124+$ pounds.

Second case. That between the limits 2″.0 and 3″.2 upon the scale, the force required to produce the same amount of compression (0″.1) was $=x=275.075$ pounds, with a probable error of $\pm 0.5148+$ pounds.

Third case. And between the limits 3″.2 and 3″.6 upon the scale, the force exerted to produce the same effect was $=x=263$ pounds, with a probable error of $\pm$ 3.109+ pounds.

IV. That for pressures ranging from 500 to 6,000 pounds, correspond-

ing to pressures of from 5,000 to 60,000 pounds per square inch where the Rodman pressure-piston is used, this instrument gave very uniform results.

The following values of x being the force required to compress the spiral springs of the Benton dynamometer through a vertical distance of 0″.1 between their respective limits, have been assumed to be the most probable values of that quantity, and have been used in forming Tables II and III, appended to this report, viz:

For readings on the scale between 1″.10 and 2″.00; $x = 270$ pounds.

For readings on the scale between 2″.00 and 3″.20; $x = 275$ pounds.

For readings on the scale between 3″.20 and 3″.60; $x = 263$ pounds, when the upper end of the scale is engaged .″12 in the upper slot on the frame.

The computations were made by the method of least squares.

September 30, 1876.

Respectfully submitted.

DAVID A. LYLE,
Lieutenant of Ordnance.

To the COMMANDING OFFICER,
National Armory.

COMPUTATIONS.

Formulæ for probable error and precision.

PROBABLE ERROR.

Let—

m = the number of observations;

n, n', &c. = results found by direct observation, (in pounds avoirdupois;)

x = their arithmetical mean, being the weight in pounds required to compress springs 0″.1;

v, v', &c. = $(x - n)$ $(x' - n')$, &c. = the residual errors of observation;

ϵ = the mean error of n, n', &c;

r = the probable error of a single observation, n, n', &c.;

R = the probable error of the final result, x;

Σ = symbol representing the sum;

$$\epsilon = \sqrt{\frac{\Sigma v^2}{m-1}};$$

$$r = 0.6745.\ \epsilon;$$

$$R = \frac{r}{\sqrt{m}}.$$

PRECISION.

Peirce's Criterion for the rejection of doubtful observations.

To apply this to sets of observations involving but one unknown quantity, let—

m = the number of observations taken;

n = the number of doubtful observations to be rejected, (to be found by trial;)

ϵ = the mean error of one observation in the set of m observations;

v, v', &c. = the residual errors of the observation;

and x = the ratio of the required limit of error for the rejection of n observations to the mean error ϵ, so that $x\epsilon$ is the limiting error.

All observations in which $x\epsilon < v$ are rejected.

FIRST CASE.

Application of Peirce's Criterion.

Observations between the limits 1″.10 and 2″.00.

m.	n.	v.	v^2.	
	Lbs.			
1	274.	3.3	10.89	$m = 27$.
2	270.	.7	.49	When $n = 1$, $x^2 = 5.479$
3	270.	.7	.49	$s^2 = 2.986$
4	270.	.7	.49	$x^2 s^2 = 16.3603$
5	270.	.7	.49	$xs = 4.0448$
6	270.	.7	.49	$\therefore xs < v$ rejects observations 25, 26, and 27.
7	270.	.7	.49	
8	270.	.7	.49	$m = 27$.
9	270.	.7	.49	When $n = 2$, $x^2 = 4.222$
10	270.	.7	.49	$s^2 = 2.986$
11	270.	.7	.49	$x^2 s^2 = 12.607$
12	270.	.7	.49	$xs = 3.5506$
13	270.	.7	.49	$\therefore xs < v$ rejects none other.
14	270.	.7	.49	
15	270.	.7	.49	
16	270.	.7	.49	
17	270.	.7	.49	
18	270.	.7	.49	*Rejected by Peirce's Criterion.
19	270.	.7	.49	
20	270.	.7	.49	
21	270.	.7	.49	
22	270.	.7	.49	
23	270.	.7	.49	
24	270.	.7	.49	
25	*275.	4.3	18.49	
26	*275.	4.3	18.49	
27	*275.	4.3	18.49	
Total = 7309. $\therefore x = 270.7$ lbs.		$\Sigma v^2 = 77.63$. $\therefore v^2 = 2.986$.		

FIRST CASE.

Probable error.

Observations between the limits 1″.10 and 2″.00.

m.	n.	v.	v^2.	
	Lbs.			
1	274.	3.83	14.6689	$m = 24$.
2	270.	.17	.0289	$\varepsilon = \sqrt{\frac{\Sigma v^2}{m-1}} = \sqrt{\frac{15.3336}{23}} = \pm 0.8165$
3	270.	.17	.0289	Probable error of single observation = 0.6745×0.8165, or $r = \pm 0.55073$ lb.
4	270.	.17	.0289	Probable error of final result = $\frac{r}{\sqrt{m}}$, or
5	270.	.17	.0289	$R = \pm \frac{0.55073}{24} = \pm 0.112418$ lb.
6	270.	.17	.0289	Hence,
7	270.	.17	.0289	$x = 270.17$ lbs. ± 0.1124 lb.
8	270.	.17	.0289	Assumed value, $x = 270$ lbs.
9	270.	.17	.0289	
10	270.	.17	.0289	
11	270.	.17	.0289	
12	270.	.17	.0289	
13	270.	.17	.0289	
14	270.	.17	.0289	
15	270.	.17	.0289	
16	270.	.17	.0289	
17	270.	.17	.0289	
18	270.	.17	.0289	
19	270.	.17	.0289	
20	270.	.17	.0289	
21	270.	.17	.0289	
22	270.	.17	.0289	
23	270.	.17	.0289	
24	270.	.17	.0289	
Total = 6484. $\therefore x = 270.17$ lbs.		$\Sigma v^2 = 15.3336$.		

SECOND CASE.

Application of Peirce's Criterion.

Observations between the limits 2″. 0 and 3″. 2.

m.	n.	v.	v^2.	
	Lbs.			
1	275.	3. 9	15. 21	$m = 43$.
2	303.	31. 9	1017. 61	When $n = 1$, $\kappa^2 =$ 6. 416
3	275.	3. 9	15. 21	$\varepsilon^2 =$ 233. 315
4	275.	3. 9	15. 21	$\kappa^2 \varepsilon^2 =$ 1496. 945
5	275.	3. 9	15. 21	$\kappa\varepsilon =$ 38. 69
6	275.	3. 9	15. 21	
7	275.	3. 9	15. 21	
8	275.	3. 9	15. 21	$\therefore \kappa\varepsilon < v$ rejects 12, 13, and 14.
9	275.	3. 9	15. 21	
10	275.	3. 9	15. 21	
11	275.	3. 9	15. 21	
12	*216.	55. 1	3036. 01	$m = 43$.
13	*220.	51. 1	2611. 21	
14	*220.	51. 1	2611. 21	When $n = 2$, $\kappa^2 =$ 5. 114
15	275.	3. 9	15. 21	$\varepsilon^2 =$ 233. 315
16	275.	3. 9	15. 21	
17	275.	3. 9	15. 21	$\kappa^2 \varepsilon^2 =$ 1193. 1763
18	275.	3. 9	15. 21	
19	275.	3. 9	15. 21	$\kappa\varepsilon =$ 34. 5423
20	270.	1. 1	1. 21	
21	270.	1. 1	1. 21	
22	270.	1. 1	1. 21	$\therefore \kappa\varepsilon < v$ rejects none other.
23	275.	3. 9	15. 21	
24	275.	3. 9	15. 21	
25	275.	3. 9	15. 21	
26	275.	3. 9	15. 21	
27	275.	3. 9	15. 21	
28	275.	3. 9	15. 21	* Rejected by Peirce's Criterion.
29	275.	3. 9	15. 21	
30	275.	3. 9	15. 21	
31	275.	3. 9	15. 21	
32	275.	3. 9	15. 21	
33	275.	3. 9	15. 21	
34	275.	3. 9	15. 21	
35	275.	3. 9	15. 21	
36	275.	3. 9	15. 21	
37	275.	3. 9	15. 21	
38	275.	3. 9	15. 21	
39	275.	3. 9	15. 21	
40	275.	3. 9	15. 21	
41	275.	3. 9	15. 21	
42	270.	1. 1	1. 21	
43	270.	1. 1	1. 21	
Sum=11659.		$\Sigma v^2 =$9799. 23.		
x=271. 1 lbs.		$\therefore \varepsilon^2$=233. 315.		

SECOND CASE.

Probable error.

Observations between the limits 2″.0 and 3″.2.

m.	n.	v.	v^2.
	Lbs.		
1	275.	.075	.005625
2	303.	27.925	779.805625
3	275.	.075	.005625
4	275.	.075	.005625
5	275.	.075	.005625
6	275.	.075	.005625
7	275.	.075	.005625
8	275.	.075	.005625
9	275.	.075	.005625
10	275.	.075	.005625
11	275.	.075	.005625
12	*216.	.....	.....
13	*220.	.....	.....
14	*220.	.....	.....
15	275.	.075	.005625
16	275.	.075	.005625
17	275.	.075	.005625
18	275.	.075	.005625
19	275.	.075	.005625
20	270.	5.075	25.755625
21	270.	5.075	25.755625
22	270.	5.075	25.755625
23	275.	.075	.005625
24	275.	.075	.005625
25	275.	.075	.005625
26	275.	.075	.005625
27	275.	.075	.005625
28	275.	.075	.005625
29	275.	.075	.005625
30	275.	.075	.005625
31	275.	.075	.005625
32	275.	.075	.005625
33	275.	.075	.005625
34	275.	.075	.005625
35	275.	.075	.005625
36	275.	.075	.005625
37	275.	.075	.005625
38	275.	.075	.005625
39	275.	.075	.005625
40	275.	.075	.005625
41	275.	.075	.005625
42	270.	5.075	25.755625
43	270.	5.075	25.755625
$m=40$.	Sum=11003.	$\Sigma v^2=908.775000$.	
$x=275.075$ lbs.			

$m=40$.

$$r=\sqrt{\frac{\Sigma v^2}{m-1}}=\sqrt{\frac{908.775}{39}}=\pm 4.8272+$$

Probable error of single observation = 0.6745 × 4.827 +, or $r=\pm 3.2558$ lbs.

Probable error of final result $=\frac{r}{\sqrt{m}}$, or

$$R=\pm\frac{3.2558}{\sqrt{40}}=\pm 5.014789 \text{ lb.}$$

Hence, $x=275.075$ lbs. ± 0.514789 lb.
Assumed value, $x=275$ lbs.

*Rejected by Peirce's Criterion, not included in this computation.

THIRD CASE.

Probable error.

Observations between the limits of 3″.2 and 3″.6.

m.	n.	v.	v^2.
	Lbs.		
1	275.	12.	144.
2	275.	12.	144.
3	270.	7.	49.
4	270.	7.	49.
5	250.	13.	169.
6	250.	13.	169.
7	250.	13.	169.
Sum = 1840.		$\Sigma v^2 = 892$.	
$x = 263$ lbs.		$\epsilon^2 = 148.83$	

$m = 7$.

When $n = 1$ $\kappa^2 = 2.866$

$\epsilon^2 = 148.83$

$\kappa^2 \epsilon^2 = 426.54706$

$\kappa\epsilon = 20.653+$

$\therefore \kappa\epsilon < v$ rejects none.

Probable error.

$$m = 7;\ \epsilon = \sqrt{\frac{\Sigma v^2}{m-1}} = \sqrt{\frac{892}{6}} = \pm 12.1992$$

Probable error of single observation = 0.6745 × 12.1992, or $r = \pm 8.222632$ lbs.

Probable error of final result $= \frac{r}{\sqrt{m}}$, or

$$R = \pm \frac{8.2286}{\sqrt{7}} = \pm 3.109 \text{ lbs.}$$

Hence, $x = 263$ lbs. ± 3.109 lbs.

Assumed value, $x = 263$ lbs.

NOTE.—The probable error in this case would have been less had the number of observations been greater, provided the observations had not varied much from those taken.

BENTON'S DYNAMOMETER.

TABLE I.—*Showing the lengths of the two cuts made in the same copper blocks for the same reading of the dynamometer.*

Number on copper block.	Weight of copper block.	Reading of Benton machine for both cuts.	Pressure per square inch in pounds.	Pressure on springs = 0, initial reading before making.		Length of—		Remarks.
				1st cut.	2d cut.	1st cut.	2d cut.	
	Grains.	*Inches.*		*Inches.*	*Inches.*	*Inches.*	*Inches.*	
21	832.5	1.50	15800	0.98	0.98	0.595	0.595	The Adams cutter for Rodman pressure-piston used.
22	825.5	1.62	19040	Lost.	.98	.63	.63	
23	827.5	1.70	21200	.98	.99	.675	.675	The steel scales used were made by Brown & Sharp, of Providence, R. I.
24	826.5	1.80	23900	Lost.	.99	.695	.695	
25	832.5	1.90	26600	Lost.	.99	.745	.745	
26	827.0	2.00	29300	.99	.99	.77	.77	For prints of these blocks and cuts, *vide* Plate III.
27	829.0	2.10	32050	.99	.99	.82	.82	
28	836.0	2.20	34800	.99	.99	.83	.82	
29	828.0	2.30	37550	.99	.99	.89	.87	
30	837.0	2.40	40300	.99	.99	.90	.88	
31	830.5	2.50	43050	.99	.99	.92	.915	
32	835.0	2.60	45800	.99	.99	.945	.915	
33	828.0	2.70	48550	.99	.99	.975	.955	
34	821.5	2.80	51300	.99	.99	.985	.96	
35	836.0	2.91	54325	Lost. *.99 †.98	.99	1.02	.98	

* Initial reading at end of experiments.
† Initial reading 16 hours after.

TABLE II.—BENTON'S DYNAMOMETER.

A.

Weights required to compress the spiral springs of Benton's dynamometer, as determined by actual experiment, together with the corresponding readings upon the scale.

Reading of scale.	Weight required to compress springs 0″.1.	Total weight.	Reading of scale.	Weight required to compress springs 0″.1.	Total weight.
Inches.	*Lbs.*	*Lbs.*	*Inches.*	*Lbs.*	*Lbs.*
1.10	.....	500	2.40	275	4030
1.20	270	770	2.50	275	4305
1.30	270	1040	2.60	275	4580
1.40	270	1310	2.70	275	4855
1.50	270	1580	2.80	275	5130
1.60	270	1850	2.90	275	5405
1.70	270	2120	3.00	275	5680
1.80	270	2390	3.10	275	5955
1.90	270	2660	3.20	275	6230
2.00	270	2930	3.30	263	6493
2.10	275	3205	3.40	263	6756
2.20	275	3480	3.50	263	7019
2.30	275	3755	3.60	263	7282

B.

Weights in pounds required to compress spiral springs through fractional parts of an inch less than one-tenth, (0″.1.)

Reading of scale.	Between—		
	1″.10 and 2″.	2″. and 3″.2.	3″.2 and 3″.6.
Inches.	*Lbs.*	*Lbs.*	*Lbs.*
.01	27	27.5	26.3
.02	54	55.0	52.6
.03	81	82.5	78.9
.04	108	110.0	105.2
.05	135	137.5	131.5
.06	162	165.0	157.8
.07	189	192.5	184.1
.08	216	220.0	210.4
.09	243	247.5	236.7
.10	270	275.0	263.0

NOTE.—Scale, 50 divisions to one inch. Upper end of scale engaged 0″.12 in slot on frame. The upper terminal plane is assumed as the zero of the scale.

TABLE III.—BENTON'S DYNAMOMETER.

C.

Scale of pressures.—Reading of the scale of Benton's dynamometer corresponding to pressure in pounds per square inch; readings estimated from the zero of the scale.

Reading of scale.	Pressure.	Reading of scale.	Pressure.
Inches.	*Lbs.*	*Inches.*	*Lbs.*
1.10	5000	2.40	40300
1.20	7700	2.50	43050
1.30	10400	2.60	45800
1.40	13100	2.70	48550
1.50	15800	2.80	51300
1.60	18500	2.90	54050
1.70	21200	3.00	56800
1.80	23900	3.10	59550
1.90	26600	3.20	62300
2.00	29300	3.30	64930
2.10	32050	3.40	67560
2.20	34800	3.50	70190
2.30	37550	3.60	72820

D.

Pressure in pounds per square inch for fractional readings of scale less than one-tenth (0″.1) *of an inch.*

Reading of scale.	Pressure between limits.		
	1″.10 and 2″.	2″ and 3″.2.	3″.2 and 3″.6.
Inches.	*Lbs.*	*Lbs.*	*Lbs.*
.01	270	275	263
.02	540	550	526
.03	810	825	789
.04	1080	1100	1052
.05	1350	1375	1315
.06	1620	1650	1578
.07	1890	1925	1841
.08	2160	2200	2104
.09	2430	2475	2367
.10	2700	2750	2630

NOTE.—Scale, 50 divisions to one inch. Upper end of scale engaged 0″.12 in slot on frame. The upper terminal plane is assumed as the zero of the scale.

Tables C and D are computed from Tables A and B, upon the hypothesis that the area of the cross-section of the Rodman pressure-piston is one-tenth of one square inch.

THE BENTON DYNAMOMETER.

Explanation of plates.

PLATE I.

Fig. 1. Front elevation without appendages.
Fig. 2. Side elevation—casing removed on one side, showing springs, &c.
Fig. 3. The two nests of springs—section of upper nest.
Fig. 4. Plan of same and cylindrical casing, showing manner of breaking joints.
Fig. 5. Upper face of upper guide-block.
Fig. 6. Upper face of lower guide-block.
Fig. 7. Plan of dynamometer—pedestal and wheel removed.
Fig. 8. Wheel.

PLATE II.

Fig. 1. Plan of block for housing.
Fig. 2. Elevation of same.
Fig. 3. Plan of housing for copper block and cutter.
Fig. 4. Elevation of same.
Fig. 5. Side elevation of Adams's cutter.
Fig. 6. End elevation of same.
Fig. 7. Base and longitudinal section of limit-gauge.
Fig. 8. Plan of same.
Fig. 9. End elevation of copper block.
Fig. 10. Plan of same.

PLATE III.

Figs. 21–35. Prints from copper blocks showing size of cuts.
a shows cuts made for reading of 3″.5.
b shows single cut for reading of 3″.5.

CUTTERS AND PISTONS FOR PRESSURE-GAUGES.

[Spiral cutters not included in this report.]

The descriptions of the forms and dimensions of cutters and pistons for pressure-gauges have been published in a rather fragmentary manner, and so intermingled with correlative subjects that, to arrive at the history of what has been done, we are obliged to consult the several reports through which the various details are scattered. In view of these facts, it is thought desirable to collect into one report all the details concerning these instruments; in other words, to give a description of them as written by those who first used them. The exact language of the writers has been retained in making extracts from their reports. Some of the subject-matter of these extracts is irrelevant, and bears but indirectly upon the object in view, but it could not be avoided, as the intention is to present the writers' statements entire. In August, 1854, Major Wade submitted a report on the strength and properties of metals, and on the manufacture of bronze and iron cannon at foundries under his supervision during the years 1850 and 1851, from which the following extracts are taken:

The comparative softness or hardness of metals is determined by the bulk of the cavities, or indentations, made by equal pressures; the softness being as the bulk directly, and the hardness as the bulk inversely.

The instrument used for making the indentations is represented in Figs. 1, 2, 3, and 4, Plate I. The form of the indenting part of it is a pyramid; the sides and opposite angles of its base are equal.

The longest diagonal of its base is 1 inch, the shortest 0″.2, and the height of the pyramid is 0″.1. The planes of the sides intersect at the penetrating edge, at an angle of 90°. (See "Experiments on Metals for Cannon," page 259.)

Again:

Of the different forms of cavity made by the indenting-tools, that of the pyramid is preferred. The cone, with an angle of 90° at its point, will make a cavity about equal in bulk to that made by the pyramid under equal pressures; but the latter may be more accurately determined because it makes a longer mark, and minute differences are thus rendered more sensible. The form of the pyramid may, however, be improved by making the longest diagonal of its base 1″.25 instead of 1″, and by making its sides meet, in the penetrating edge, at an angle of 60° instead of 90°; the height remaining the same as at present. This would make a longer line and mark minute differences more accurately. (See "Experiments on Metals for Cannon," page 266.)

General Rodman, in his report on experiments made in 1857–'58 for determining the absolute pressure of gas in the bore of a gun, gives the following:

A 42-pounder gun was pierced through the cascabel, along the axis, and at intervals of two calibers along its side and perpendicular (except that nearest the muzzle) to its exterior surface, with holes 0.38 inch in diameter and extending through to the bore. Concentric with these holes were bored others 1.5 inches in diameter and 1.5 inches deep.

These holes were tapped, and the housing which contained the indenting-tool and the copper specimen to be indented was screwed into one of them when in use, the others being filled with plugs, tightly screwed in. The diameter of the indenting-piston, on the inner end of which the pressure of the gas was exerted, was 0.368 inch. Fig. 5, Plate IV, shows a section through the axis, and Fig. 8 a side elevation of the indenting apparatus. The indenting-tool had a snug *working fit* in the housing. The hole in the housing, shown at c, and the recess around the stem of the indenting-tool which it enters, were made for the purpose of letting out any gas that might pass the piston, and thus prevent its acting against the shoulder of the indenting-tool, and for this purpose it answered very well.

The mode of determining pressures by this apparatus is as follows:

The shank or piston of the indenting-tool, and the hole in the housing into which it is inserted for use, are well cleaned and oiled, and the indenting-tool inserted into the housing, which is then screwed into the gun, and a disk of soft copper placed on the point of the indenting-tool, the disk being held in position by the screw *s* acting either *upon a second* copper disk or upon a piece of iron having a plane surface next the disk

to be indented. The pressure exerted upon the inner end of the indenting-piston forces the point of the indenting-tool into the copper disk when the gun is fired. This disk is then removed to the testing-machine, and the pressure required to produce an equal indentation with the same tool in the same disk, or one from the same bar of copper, is accurately weighed; then knowing the area of a cross-section of the indenting-piston, the pressure per square inch is calculated. For the purpose of getting greater accuracy of results, the indenting-point is very broad and thin, so as to make a very *long* cut as compared with its breadth and depth. With the tool used in these experiments, a difference of pressure of 25 pounds was distinctly perceptible when added to a pressure of 3,000 pounds on the indenting-tool, and corresponding to a pressure of about 3,000 pounds per square inch in the gun, or to an error of less than 250 pounds in 3,000 pounds. So that the indications of this instrument may be safely regarded as approximating to within 1,000 pounds of the true pressure, even for the greatest pressures exerted, and much nearer for the smaller pressures. This method of determining the pressure of gas in the bore of a gun, and a modification of it, involving the use of a spring in lieu of the indenting-tool and specimen, was suggested by me to Maj. W. Wade as early as 1851, who thought well of it. He, however, left the employ of the Department about that time, and I never had an opportunity of applying it till in these experiments, when it was first applied to the experimental 42-pounder gun. (See "Experiments on Metals for Cannon," pp. 174, 175.)

In the foregoing experiments with the 42-pounder gun, the indentations from which the pressures at the bottom of the bore were determined were made by a piston having a much longer stem than that which made the indentations from which the pressures at other points were determined. All the foregoing results with that gun show the pressure at the bottom of the bore to be very considerably less than that at two calibers. In order to reconcile this discrepancy, a piston extending into the surface of the bore was used at two calibers, and gave at the first fire a pressure of 23,505 pounds, and 26,560 at the second fire, with 10 pounds of powder and one solid shot, the piston sticking so tightly in the gun and housing that it was with difficulty that it was extracted.

The cause of the piston sticking was that the powder entered the space around the piston and clogged it so tightly that its indications of pressure were far below those obtained with the short piston at the same point, or those obtained at the breech. The use of both the long pistons was then abandoned, and one, whose inner end did not extend quite through the housing when in position, with a gas-check of thin brass inserted, so as to prevent the gas from clogging the stem, was adopted. The gas-check was a hollow cup made of sheet-brass, and of the same or a little greater diameter than the stem of the indenting-piston; it was inserted into the mouth of the housing with its mouth toward the bore of the gun. Its position is shown at *g* in the section of the indenting apparatus, (Fig. 5, Plate I.) This arrangement was found to entirely prevent the clogging of the stem of the indenting-tool, it being generally as free from powder stain when removed as when inserted. (See "Experiments on Metals for Cannon," pp. 179, 180.)

The description of the Rodman pressure-piston given in the Ordnance Manual of 1861 is substantially the same as that given above, except that the hole drilled into the bore of the gun to receive the shank of the housing is given as 0″.4 in diameter, instead of 0″.38, and the gas-check is made of thin copper instead of brass. The Ordnance Manual also states that "this shank (of the housing) has a cylindrical hole through its axis 0.37 inch in diameter, into which the piston fits closely."

RODMAN'S INTERNAL PRESSURE-GAUGE.

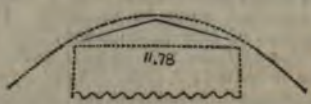
"The pressure of the gas in the 15-inch gun was determined by the method of indentations, as heretofore explained, except that the apparatus was placed wholly within the bore of the gun, being inserted in the bottom of the cartridge-bag, and having the charge filled in over it, so that no powder should get under it and come between it and the bottom of the bore when rammed home in the gun. The accompanying diagram (Plate V) shows the construction of this instrument; AA, outer cylinder; BB, screw-plug for closing mouth of outer cylinder; *hh*, copper gasket, to form gas-tight joint; C, specimen of copper to be indented; I, indenting-tool; *p*, indenting-piston; *g*, gas-check. In using this instrument, all its parts, except the exterior of the outer cylinder, are carefully cleaned before each fire, and the threads of the screw-plug and the indenting-piston carefully oiled: the copper specimen is then placed in the bottom of the cylinder, the indenting-piston inserted into the screw-plug, and with the outer cylinder horizontal the plug is screwed home, being afterwards tightly set in with a wrench while the cylinder is held in a vise. The cylinder is then carefully set down upon its

closed end, and the indenting-piston gently pushed down till the point of the indenting-tool rests upon the copper specimen; a small gas-check is then inserted, mouth outward, till it rests upon the end of the indenting-piston. It gives additional security against the passage of gas to place a small wad of cotton or tow over the gas-check, pressing it in firmly without driving, as a very light blow, several times repeated, might give a greater indentation than that due to the pressure to which it was to be subjected, and thus give erroneous results. The instrument is inserted into the gun with the screw-plug toward the muzzle, and is generally found in the bore of the gun after its discharge, when the screw-plug is withdrawn and the specimen removed, having an indentation in its surface, due to the pressure that has been exerted upon the outer end of the indenting-piston. The indications of pressure are found to be, generally, something less, for equal charges, by this instrument than by the external housing; this may be, and probably is, due to the retardation of the rate of inflammation of the charge by the presence of the instrument, and to the heat absorbed by it. For these reasons this instrument should be as small as may be compatible with its practical use. To enable those who have not the means of determining the pressure corresponding to a given length of indentation, to obtain approximate results from the pressure-gauge, the following table* was constructed by accurately measuring the length of cut due to each 100 pounds from 100 to 9,000. The indentations were made with an indenting tool of the dimensions given in the plate, (Plate V,) showing the construction of the pressure gauge, and in the same bar of annealed copper. These results were plotted, and the accompanying mean curve constructed from them, and from this curve† the lengths of cuts given in the table were taken." (See "Experiments on Metals for Cannon," pp. 299, 300.)

In reference to the Rodman internal pressure-gauge, Commander Marvin, U. S. Navy, (see "Art. 1337, p. 492, Naval Ordnance and Gunnery,") gives the following: "The indications of pressure by this instrument are generally found to be something less for equal charges of powder than those by the external gauge; one reason for this is probably owing to the fact that in the external gauge the gas has a considerable space to travel through between the powder-chamber and the indicating parts, so that before reaching the piston the gases have attained a high *vis-viva*, especially with quick-burning powders."

CIRCULAR CUTTERS.

The Adams cutter.—In June or July, 1875, Major Farley, Ordnance Department, U. S. A., directed Mr. J. S. Adams, a gauge-maker at the National Armory, to make two cutters, having exactly the same dimensions, for the Rodman pressure-gauge, giving him as a model a pressure-gauge made at Frankford arsenal, designed for use with muskets. The knife-edge of this model was of the usual pyramidal form of the Rodman cutter, and was 0″.78 in length. Mr. Adams found that it was a mechanical impossibility to so file the faces of this pyramid as to have the two cutting or indenting edges identical in form and dimensions. He accordingly conceived the idea of turning a beveled edge with a circular profile upon the perimeter of a steel disk, as this could be accurately done in a lathe or mill, thus securing the perfect agreement of all cutters taken from that disk, and at the same time diminishing both the cost and time of fabrication. Mr. Adams took the Rodman cutter above mentioned, and found by trial a circle which would pass through the three angular points of the edge, as shown here—



This circle, whose diameter he found to be 2″.88, he assumed as the one which should form the cutting edge of the new series of cutters to be

* Table omitted. † Omitted.

fabricated. The steel disk was 0″.233 thick. It was pierced with a central hole 1″ in diameter for convenience of adjustment to an arbor of a lathe or mill already on hand. The bevels upon the two sides were equal. Hence, the cutting edge itself is an arc of a circle with a diameter equal to 2″.88, and is formed by the intersection of two right cones, turned base to base, (bases circular,) and having a common axis. This makes the *bottom* of the cut, or indentation in the copper block, an arc of a circle, and the limiting lines of the *same* indentation upon the surface of the block, arcs of two equal hyperbolas. The form and dimensions of the disk and cutter are given in Figs. 1, 2, and 3, Plate VI.

The *cutter-block* is rectangular in shape, 1″.18 long, 0″.74 wide, and 0″.74 thick. A groove is planed in one of the longer sides 0″.2 deep, and sufficiently wide to receive the indenting edge. On the opposite side is drilled a hole 0″.4 deep and 0″.5 in diameter, for the reception of the larger end of the piston. In the bottom of this hole a smaller one is countersunk, for a small screw which projects into the cutter-groove and serves to hold the indenting segment in position after insertion. This segment projects 0″.3 from the cutter-block and is engaged 0″.2 in that block. There have been three Adams cutters of the same size taken from the disk and set in cutter-blocks, viz: Cutter No. 1, made for the National Armory, and now on hand at this place; cutter No. 2, made for Hazard Powder Company, of Hazardville, Conn. [This cutter was broken in the hands of the company by the accidental omission of the copper block from the housing while firing.] Cutter No. 3, made for Hazard Powder Company, (to replace No. 2.) There is material for another cutter still upon the disk.

NATIONAL ARMORY CIRCULAR CUTTER.

This is a modification of the Adams cutter, from which it differs only in the details of its form and dimensions. The diameter of the circle which forms the cutting-edge is 3″; the angle formed by the elements of the two right cones whose intersection forms that edge is 60° instead of 61° 20′. The altitudes of these cones are the same, and are equal to 0″.866. The thickness of the disk is 0″.25. The angle of 60° was adopted for the edge as being an angle which could be accurately formed in a turning-lathe without difficulty; as almost every machinist possesses an equilateral triangular gauge by which he can verify at any instant the angle included between the legs of the striding-gauge that he uses to guide him in turning the bevels. The diameter and thickness of the disk-plate were chosen with reference to retaining the angle of 60°, and with reference to ease of exact measurement by practical mechanics. By assuming these dimensions the strength of the cutter is not impaired; it is rendered a little more sensitive to small differences of pressure than the Adams cutter; and its dimensions, both linear and angular, are easily preserved in fabrication by any one of ordinary mechanical skill. The limits of these linear dimensions, whether expressed in hundredths or thousandths of an inch, can always be made to fall upon the larger and more common divisions of almost any English scale of inches. The special advantage of the circular cutting or indenting edge is that it can be readily pressed into the indentation, previously made in the copper block or disk while in the piece, upon its removal to the dynamometer or testing-machine. In the case of the pyramidal cutter, it is, and always will be, a matter of considerable difficulty to make the apex of the pyramid coincide with its former position, in adjusting it in a dynamometer for the purpose of getting the reading of the estimator or the setting of the

limit-gauge, in order to govern the operator in making the similar secondary cut or cuts from or by means of which the pressures are determined. The more accurately the cutter is inserted into the indentation made by the force of discharge, and the greater the precision of the adjustment of the limit-gauge, the more nearly will be the approximation to the true pressure as determined by the dynamometer. With the circular cutter, no difficulty is experienced in adjusting its edge to the bottom of the indentation in the copper. The steel disks for the National Armory circular cutters were made in September, 1876. Two of these disks were made upon the same date by Mr. Adams. (See Figs. 1 and 2, Plate VII.)

NATIONAL ARMORY CIRCULAR CUTTER NO. 1.

The indenting segment ("*a*," Fig. 1, Plate VII) for this cutter was taken from one of the disks above mentioned, to be used in the Rodman internal pressure-gauge belonging to the Department of Ordnance and Gunnery at the U. S. Military Academy, West Point, N. Y. It is set in a cylindrical cutter-block, 0″.54 in length and 1″.5 in diameter, made to fit the cylinder of the pressure-gauge. The segment is held in position by two screws sunk flush with the upper surface of the block. The details of the block and cutter are shown in Fig. 3, Plate VII. The copper disks (Fig. 8, Plate VII) used in the above pressure-gauge are 1″.4 in diameter and 0″.5 thick. A special housing and limit-gauge were made for the Benton dynamometer, to be used in conjunction with this cutter-block and the copper disks.

The housing.—The housing (Figs. 4, 5, and 6, Plate VII) is made of steel, 2″.5 long, 3″ wide, and 1″.4 high, (exterior dimensions.) The top has a circular hole 1″.5 in diameter, into which the cutter-block is inserted. The cylindrical surface of this hole guides and retains the block in a vertical position. On the bottom of the housing is a sliding-block (Fig. 7, Plate VII) of steel, pierced with a hole 1″.4 in diameter to hold the copper disks. The motion of this sliding-block is limited laterally by two side screws upon each side of the housing. Its longitudinal motion toward the rear is arrested by a stop screwed on to the rear of the housing. This *stop* has a groove parallel to its upper edge, in order to avoid interference with the sliding motion from the accidental lodgment of dust or dirt between the stop and sliding-block.

The limit-gauge.—The limit-gauge, (Fig. 1, Plate VIII,) designed for use with this housing, consists of two parts having a common longitudinal axis. The two parts are connected by a male and female screw, as shown in the figure. The upper part has a friction-screw (*a*) attached, to assist in preserving the adjustment. The lower part has a rectangular base 1″ long and 0″.5 wide; near the shoulder toward the upper end a light handle (*b*) is screwed in for convenience in use. The upper and lower bases of the instrument are in parallel planes, and the length of the gauge must be adjusted to the distance between the surfaces of the guide-blocks of the Benton dynamometer.

Manner of using.—On taking the piston, cutter, and copper disk from the pressure-gauge after firing, it will be found that an indentation has been made in the middle of the disk. Remove the disk and cutter to the Benton dynamometer. Place the copper in the sliding-block with the indentation running lengthwise of the block, and put them both into the housing; then carefully insert (so as to avoid injuring its edge) the cutter through the round aperture, bring the indentation in the copper directly under it by sliding the block and disk, and press down the cutter firmly into the cavity with the thumbs. Turn the cutter-block and

copper disk (both being free to move) until the mark on the top and side of the block coincides with the mark across the top of the housing. By keeping the cutter and housing in this relative position the parallelism of the middle and secondary cuts are secured. Now place the housing upon the block of the dynamometer and lower the screw until the upper guide-block comes to a bearing upon the cutter-block; give the screw a few turns downward to insure the proper insertion of the edge of the cutter into the indentation. [When the side of the scale is used which contains fifty divisions to the inch, turn down the screw until the reading on the scale is about 1″.2; *provided*, the scale be engaged 0″.12 in the upper slot. There is no danger of enlarging the indentation so long as the pressure applied to "settle" the cutter is less than that which produced the indentation.] Without raising the screw, adjust the limit-gauge to the distance between the two guide-blocks; when nearly to the proper height, tighten slightly the friction-screw, and then complete the adjustment so as to barely allow the gauge to slide back and forth between the guide-blocks without binding. Lay the limit-gauge to one side, taking the greatest care that its adjustment is not changed by the accidental turning of its screw until after the *secondary* cuts are made. Now, with the thumb and forefinger of the right hand, raise the cutter lightly until its edge is just clear of the copper, and, by the pressure of the left thumb, slide the block with the copper disk to the right or left until its side brings up against the side screws, keeping its rear end abutting against the stop; lower gently the cutter, keeping the mark on it coincident with that on the housing; bring down the screw slowly until it bears upon the cutter-block, then resume the limit-gauge and have the screw turned down until the thread of light between the top of the gauge and upper guide-block is just disappearing, but do not let it get "pinched." Remove the gauge and take the reading on the scale of the dynamometer. Ease up the screw and raise the cutter-block as before, with thumb and finger, and slide the block with the copper disk to the other side of the housing, and make similarly a second cut and take the reading. A mean of these two readings (which should differ but little from each other if proper care be taken) will be the reading corresponding to the pressure required; with this mean reading as an argument, enter Table III, "C" and "D," for Benton's dynamometer, and take out the pressure corresponding to it, *provided* the area of the piston be one-tenth of one square inch.

NATIONAL ARMORY CIRCULAR CUTTER NO. 2.

This cutter was made and designed to be used at this place in the Rodman external pressure-gauge for determining the pressure of gas in the chambers of Springfield rifles and carbines. The cutter-block is made of hardened steel, rectangular in shape, 1″.18 long, 0″.76 high, and 0″.74 thick. The groove for the indenting segment and the hole for the larger end of the piston are identical with those described for the Adams cutter. The number (2) of the cutter is stamped upon the side and end of the indenting edge. The diameter of the cutting-edge is indicated by the characters "3″D." stamped upon the other side. This block, and the cutter, is shown in Fig. 2, Plate VIII.

NATIONAL ARMORY CIRCULAR CUTTER NO. 3.

This cutter is identical with National Armory circular cutter No. 2 in its dimensions. It was made for Frankford arsenal, to be used in connection with a musket housing. The piston belonging to it is 0″.357 in diameter. It is shown in its true dimensions in Plate IX.

PISTONS.

The indenting-pistons used in the service are found to vary in their diameters. The pressure of the gas is exerted upon their inner ends, and varies directly with the area pressed. It is desirable to have a series of pistons adopted which shall have the same area of cross-section. In practice, the area of these pistons has generally been assumed to be one-tenth of one square inch. The following table gives the diameters, areas, and pressures upon those pistons of which the dimensions are known, neglecting friction, and supposing the pressure per square inch to be 100,000 pounds.

TABLE.

Pistons.	Diameter of pistons.	Area of pistons.	Pressure upon pistons.	Remarks.
	Inches.	*Sq. in.*	*Lbs.*	
Ordnance Manual, 1861	.37	.107521	10752.1	0″.37 given here because this number has sometimes been used in calculating pressures.
Frankford arsenal, (musket)	.369	.106940	10694.0	Made for National Armory.
Rodman	.368	.106362	10636.2	*Vide* "Experiments on Metals for Cannon," pp. 174, 175.
Metcalfe	.357	.100098	10009.8	Made for use with "spiral cutters."
Theoretical	.3568+	.100000	10000.0	True diameter = 0″.356824743746.
National Armory circular cutter.	.356	.099538	9953.8	Also for Adams's cutter.
National Armory circular cutter No. 3.	.357	.100098	10009.8	Made at National Armory for Frankford arsenal.
West Point internal pressure-gauge.	.355	.0989798	9897.98	

Little is known in regard to the effect of friction upon these short pistons. The friction of the gas-check against the walls of the hole would render the indicated, less than the actual pressures. A uniform system of pistons and cutters should be established in order to render the results obtained comparable. The more nearly the conditions are assimilated the greater will be the approximation of the relative pressures to agreement. At the present time each piston necessitates a separate table of pressures, and when the length of the cuts is required to determine the pressures a table must be constructed for each cutter.

Respectfully submitted.

D. A. LYLE,
First Lieutenant of Ordnance.

NATIONAL ARMORY, *December* 11, 1876.

To the COMMANDING OFFICER,
National Armory.

TABLE I.—*National Armory circular cutter No. 1, made for West Point.*

Internal pressure-gauge. (See Plate X.)

Date.	Number of copper disk.	No. 1, middle cut.			Cut No. 2.			Cut No. 3.			Pressure. Mean of those in columns Nos. 9 and 11.
		Reading Benton dynamometer.	Length of cut.	Corresponding pressure.	Reading Benton dynamometer.	Length of cut.	Corresponding pressure.	Reading Benton dynamometer.	Length of cut.	Corresponding pressure.	
1876.		*In.*	*In.*	*Lbs.*	*In.*	*In.*	*Lbs.*	*In.*	*In.*	*Lbs.*	*Lbs.*
November 15	4	1.6	.565	18500	1.6	.55	18500	1.6	.55	18500	18500
November 15	5	1.8	.62	23900	1.8	.62	23900	*1.67	.61	18500	21200
November 20	8	1.8	.63	23900	1.83	.63	24725	1.81	.62	24175	24400
November 9	2	2.0	.675	29300	2.01	.675	29575	2.00	.66	29300	29437.5
November 15	6	2.2	.72	34800	2.22	.71	35350	2.17	.695	33975	34662.5
November 9	1	2.5	.77	43050	2.5	.77	43050	2.5	.77	43050	43050
November 15	7	2.8	.84	51300	2.7	.81	48550	2.77	.825	50475	49512.5
November 20	9	2.8	.84	51300	2.72	.815	49100	2.78	.815	50750	49925
November 9	3	3.01	.86	57075	3.03	.86	57625	2.92	.86	54600	56112.5
November 20	10	3.0	.86	56800	3.02	.855	57350	2.94	.85	55150	56250

*Error in reading the scale of Benton dynamometer; but as it was so read it is placed upon the record.

NOTE.—Cuts No. 1 (middle cuts) were made a few days before the others, in the dynamometer. The other two cuts were made by the limit-gauge and then the readings taken. No more care was taken in adjusting the limit-gauge than that likely to be observed by an ordinary operator. Care should be exercised by the person who turns down the screw, as he will be likely to "pinch" the gauge, especially so with high pressures.

TABLE II.—*Pressures in chamber of Springfield rifle.*

Instruments: National Armory Circular Cutter No. 2; Benton Dynamometer and Limit-gauge.

Powder from American Powder Co.		Reading of Benton dynamometer.		Pressures per square inch.			Lengths of cuts.			Initial velocities, means.	
		2d cut.	3d cut.	2d cut.	3d cut.	Mean.	Middle or 1st cut.	2d cut.	3d cut.	Benton thread velocimeter.	Le Boulengé chronograph.
Marks.	Spec.	*In.*	*In.*	*Lbs.*	*Lbs.*	*Lbs.*	*In.*	*In.*	*In.*	*Feet.*	*Feet.*
N 3	1.	1.76	1.76	22820	22820	22820	.735	.72	.72		
	2.	1.76	1.8	22820	23900	23360	.73	.67	.71		
	3.	1.8	1.8	23900	23900	23900	.74	.71	.73	1299.	1280.6
S 3	1.	1.72	1.71	21740	21470	21605	.72	.69	.69		
	2.	1.82	1.82	24440	24440	24440	.74	.73	.73		
	3.	1.72	1.75	21740	22550	22145	.715	.69	.69	1315.7	1293.2
A 3 and 2	1.	1.8	1.8	23900	23900	23900	.74	.72	.72		
	2.	1.88	1.84	26060	24980	25520	.75	.73	.73		
	3.	1.62	1.62	19040	19040	19040	.665	.64	.64	1318.4	1298.4
D 3	1.	1.52	1.52	16340	16340	16340	.64	.61	.61		
	2.	1.47	1.45	14990	14450	14720	.59	.57	.56		
	3.	1.46	1.46	14720	14720	14720	.56	.56	.56	1254.0	1224.2
A 2	1.	1.76	1.77	22820	23090	22955	.74	.68	.70		
	2.	1.7	1.72	21200	21740	21470	.69	.69	.685		
	3.	1.82	1.82	24440	24440	24440	.75	.72	.72	1328.3	1317.8

NOTE.—The middle cuts were made by the actual firing of service-charges of these powders in a Springfield rifle with Rodman housing attached. The second and third cuts were made in the Benton dynamometer. The initial velocities were taken and computed by Lieutenant Greer.

C.—*Densimeters for the determination of specific gravities of metals and large-grained powders for cannon.*

OFFICE OF THE CONSTRUCTOR OF ORDNANCE,
New York City, March 12, 1877.

SIR: Herewith I have the honor to submit a description, prepared by your direction, of the instruments employed, and of the processes pursued, at this office, in the determination of the specific gravities of metals and of large-grained cannon powders.

Very respectfully, your obedient servant,

CHAS. S. SMITH,
Lieutenant of Ordnance.

Lieut. Col. S. CRISPIN,
Constructor of Ordnance, U. S. A.

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1. SPECIFIC GRAVITIES OF METALS FOR CANNON.

The instrument employed in the office of the Constructor of Ordnance, in the determination of the specific gravities of metals for cannon, is simply a form of the hydrostatic balance, and was adopted in place of the hydrometer, formerly in use, in order to substitute a more expeditious process for the slow and tedious operation by the latter.

DESCRIPTION OF THE INSTRUMENT.

PLATE I.—The instrument consists of a delicate beam-scale A, having suspended from one extremity of the beam a brass bucket B, the bottom of which is perforated with holes. Underneath the bucket, and resting on a tripod D—which stands over the scale-pan in such a manner as not to interfere with either the movement of the balance or working with the pan—is a glass jar C, to contain water for the immersion of the bucket and specimen. A mark is scratched upon the jar near the top, and this mark indicates the height at which the water should, after the immersion of the bucket, always stand previous to an experiment. The immersion of the specimen causes the water to rise above this mark, immersing an additional portion of the stem of the bucket, and the latter loses, in consequence, a slight portion of its weight in reference to the beam. A correction, therefore, becomes necessary to compensate for this apparent loss in weight. To determine this correction, the bucket-stem is graduated in the following manner: The beam having been thrown into action, and the immersed bucket balanced by weights in the pan attached to the opposite arm, a mark is made upon the stem of the bucket where it is intersected by the surface of the water. The height of the water in the jar is then raised till as much more of the stem is immersed as is likely ever to be the case in practice. Another mark is then made where the stem is now intersected by the water, and the loss of weight in the bucket ascertained.

The loss in weight, for the maximum immersion of the stem, amounts to only one-tenth of a grain, while the corresponding length of stem is nearly one inch; the space between the marks, therefore, may be readily

subdivided into tenths, and the necessary corrections can thus be read off the stem in actual weight to the nearest tenth of a grain.

By using simply a thread in place of the bucket, the above correction might be neglected; but the greater convenience offered by the latter has led to its final adoption. A thermometer is suspended from the upper edge of the jar, as shown in the plate.

The balance was manufactured by Decker & Sons, of New York, and is designed to bear weights as heavy as 35,000 grains. It was adapted to the purpose of taking specific gravities, as above described, by Mr. James Green, of New York.

PROCESS OF TAKING THE SPECIFIC GRAVITY WITH THE BALANCE.

The process, with this instrument, of taking the specific gravity of a specimen of metal naturally suggests itself.

The jar being filled with water to the fixed mark, and the bucket suspended therein, the beam is thrown into action, and the weight of the immersed bucket ascertained by means of weights placed in the opposite scale-pan. This weight being noted for different temperatures, can be tabulated, and thus become a known element for all calculations of the specific gravity with this instrument. The specimen of metal is then placed in the pan underneath the jar, and weights added to the other pan till the balance of the beam is restored. The sum of these weights is the weight of the specimen in air, plus the weight of the bucket in water. The specimen is now transferred from the pan to the bucket, and replaced by weights in the pan underneath the jar, till the equilibrium is again established. The sum of these latter weights is the weight of the volume of water displaced by the specimen, plus the weight lost in the bucket, due to the immersion of an additional portion of its stem. The loss in weight is read off the bucket stem in tenths of a grain, and is to be subtracted from the weights in the pan underneath.

Denote the weight of the bucket in water, as first determined, by a; the same weight of bucket and the weight of the specimen in air, by b; the weight requisite to restore the equipoise after immersion of the specimen by c; the loss of weight in the bucket by d, and the correction for temperature by t. Then designating by D the specific gravity of the metal tested:

$$D = \frac{(b-a)\,t}{c-d}$$

Form of record of computation.

Specimen.	Weights.				Temperature of water.	Logarithms corresponding to—			$e+h-f$.	Density.
	Bucket in water.	Specimen in air $+a$.	Specimen in water $+a$.	Loss in bucket.		$b-a$.	$c-d$.	Weight of water at observed temperature.		
	a	b	c	d		e	f	h		
Steel.....	877	6428	817.25	0.25	77°	3.80-0759	2.9122225	1.9992771	.8951309	7.8548

The following table exhibits a comparison between results as determined, first with the balance, and then with the hydrometer, employing the same specimens of metal:

Specimens.	Specific gravity.		Difference.
	Balance.	Hydrometer.	
Brass	8.3760	8.3753	.0007
Wrought iron	7.6776	7.6785	— .0009
Cast iron	7.1102	7.1124	— .0022

The figures in the fourth column correspond to differences in the weights, as determined by the two instruments, amounting to fractions only of one grain.

2. SPECIFIC GRAVITIES OF LARGE-GRAINED POWDERS.

The instrument employed in this connection was constructed by Mr. H. Troemner, of Philadelphia, Pa., after the plan of one designed by the Messrs. Du Pont de Nemours & Co., and employed by them, with very satisfactory results, in testing large-grained powder at their works near Wilmington, Del.

It is a mercury densimeter, adapted, by its construction, to the reception of large grains, and having capacity for five pounds of powder, which, for convenience, is the weight of sample always employed. It differs, however, from the small densimeter in ordinary use by a combination of the different parts, such that the reservoir for containing the powder and mercury to be weighed, and the balance by means of which the weighings are made, are assembled together in one instrument. The balance also is so adapted to its special purpose as to simplify considerably the subsequent process of calculation. A great saving of labor and time is gained by this form of the instrument, and the occurrence of breaks and leaks, so frequent in the smaller one, is in great measure avoided. Again, from the much larger sample of powder employed, a fair representative result of the specific gravity of the entire lot is more likely to be secured.

DESCRIPTION OF THE INSTRUMENT.

PLATE II.—To describe more particularly, the instrument consists of three principal parts, to wit: A beam-scale, A, a reservoir, B, to contain the powder and mercury to be weighed, and of a bowl, C, to contain mercury alone. In connection therewith, an air-pump, D, is employed, the cylinder of which has communication with the interior of the reservoir through a rubber tube leading from the nozzle *z* of the pump to the glass tube *a* at the top of the reservoir. The balance is suspended from a hook, *b*, firmly secured to the roof of the housing, and its axis of suspension is a knife-edge lying in the same plane with the axes of suspension of the rods *c* and *d* and of the reservoir B. Platforms *e* and *f* are attached to the suspension-rods *c* and *d*, on which to place the weights. The latter consists of pounds, tenths of a pound, and five hundredths of a pound, marked in reference to the weights they will balance in the reservoir, and of a large unmarked weight, W, termed the "counterpoise." This counterpoise has a cavity bored in it lengthwise, the use of which will appear hereafter; its weight is about eight

pounds. The long arm of the beam is also graduated, and by means of "riders," or sliding weights, the weighings can be made to hundredths and thousandths of a pound; the graduated edge of the beam is in the same plane with the knife-edges.

h and *i* are counterpoises admitting of movement on screw-spindles passing through them, in directions that are respectively parallel and perpendicular to the beam. The former is used to adjust the arms to the same weight, the latter to regulate the sensibility of the beam. In connection with the counterpoise *h*, a light wire *k* is sometimes used along the beam to facilitate the adjustment of the arms. The beam and its appurtenances proper are of brass.

The reservoir B is of cast-iron and swings on trunnions in the yoke E. It also admits of a horizontal angular movement about the vertical pivot *l*, connecting the yoke with the suspension-stirrup *m*. A screw-cap, *n*, fitted with a leather washer, covers the mouth of the reservoir, and when removed, for the purpose of introducing powder, is attached to the hook *o*, on the outside of the yoke, so as to be included in the weighing. The mercury is admitted, or withdrawn, through the stop-cock *s*.

The conical ends of the reservoir are cast in separate pieces and are afterward screwed on to the cylinder, the joints being well leaded. Careful workmanship is requisite to prevent the formation of a ledge, or recess, at these joints, which might serve to retain sufficient portions of the mercury to affect the accuracy of the subsequent weighings. The diaphragms of wire and of leather usually employed to cover respectively the upper and lower apertures of the reservoir are not required in this instrument. The capacity of the reservoir is about seventy-eight pounds of mercury, or forty pounds of mercury and five pounds of powder. The mouth is 2½ inches in diameter, and the sample of powder fills the reservoir to about the top of the cylindrical portion. The weight of the reservoir is twenty and a half pounds.

The bowl C is of cast iron, and by means of the crank H can be raised or lowered vertically. An outlet-pipe, *p*, at the bottom of the bowl, and furnished with a stop-cock, permits of the discharge of the mercury when desired.

The air-pump is one of Ritchie's, in which, the cylinder remaining stationary, the oscillation takes place in the connecting-rod, which communicates the motion of the handle to the piston-rod.

PROCESS OF DETERMINING THE SPECIFIC GRAVITY OF A SAMPLE OF POWDER.

The beam is first accurately balanced by means of the counterpoise *h*, and the bowl filled with mercury and run up till the nozzle of the reservoir is well immersed below the surface. The large counterpoise W is then placed on the platform suspended from the shorter arm, the rubber hose slipped over the top of the glass tube of the reservoir, the air exhausted by means of the pump, and the stop-cock *s* opened to admit the mercury. The pumping is continued during the ingress of the mercury, and when the latter has risen to a fixed mark, indicated on the glass tube, the stop-cock is closed and the rubber hose removed. Usually it is necessary to run off a little of the mercury and lower its upper surface to the fixed mark. The balance of the beam is now restored by dropping fine shot into the cavity of the counterpoise W, the weight of the latter being slightly less than the weight of the filled reservoir; this done, the stop-cock *s* is opened and the reservoir emptied.

The counterpoise W is then replaced by the 5 pound weight, the screw-cap removed and hooked to the yoke, and a sufficient quantity of the powder to be tested introduced into the reservoir to balance the 5-pound weight. The screw-cap is then replaced, the counterpoise W added to the 5-pound weight, and the reservoir filled with mercury by means of the air-pump to the same height as before. The equipoise is now restored (the rubber tube having been removed) by placing weights on the platform suspended from the longer arm of the beam, and in addition by the "riders" on the beam if necessary. The sum of these weights is the weight of the mercury displaced by the powder, or of a volume of mercury equal to the volume of the powder, and the specific gravity of the latter results from the well-established principle that the specific gravities of two substances are proportional to the weights of equal volumes of those substances.

Denote the sum of the weights on the longer arm by W′, the weight of the powder by w, and the specific gravity of the mercury at the temperature of the time of observation by D, and we shall have for the specific gravity of the powder, denoted by d:

$$d = \mathrm{D}\frac{w}{\mathrm{W}'}$$

In the use of this form of the densimeter the weighings not only are rapidly and accurately made, but, it is to be observed, the actual weights required for the computation are obtained directly by a discriminative process peculiar to the balance. To simplify further, the weights for the longer arm are marked double their actual value in reference to the reservoir, so that in the computation the specific gravity is obtained by setting the decimal-point in the value of D one place further to the right, and dividing by the value of W′, as indicated on the weights, the effect being the same as multiplying by 2 both terms of the fraction $\frac{w}{\mathrm{W}'}$.

Form of record of computation.

Sample.	Double weights, corresponding to equal volumes of—		Temperature of mercury.	Specific gravity of mercury corresponding to observed temperature.	Specific gravity of powder. $\frac{10 \times \mathrm{D}}{\mathrm{W}'}$
	Powder. w.	Mercury. W′.			
Du Pont's hexagonal F. U.....	10.	76. 94	69°.	13. 54688	1. 7603

Below is a table showing a comparison between results as determined with the large and the small densimeters, the samples being selected in the following manner, viz: Six pounds having been taken out of a barrel from each lot, five pounds were retained at this office and tested here on the large densimeter, while the remaining pound of each sample was sent to Frankford arsenal to be tested there on the small densimeter. The actual density of the mercury employed was ascertained, and the corrections for temperature at the times of observations made.

The Frankford results were determined by taking a mean of two tests for each sample—about 3,000 grains being employed at a time.

Samples.	Specific gravities.		Difference.
	Small densimeter.	Large densimeter.	
Du Pont's hexagonal F. P. B., 1875	1.7885	1.7884	.001
Du Pont's hexagonal G. H., 1875	1.7834	1.7804	.003
Du Pont's hexagonal F. U., 1874	1.7536	1.7600	—.0064

The results given in the following tables were determined by Mr. J. J O'Reilly, of Frankford arsenal, with the large densimeter at the Messrs Du Pont's mills and with the small densimeter at Frankford, using portions of the same samples of powder in the latter which he had previously employed in the large densimeter, taking the precaution, however, to wipe the grains free from adhering mercury before testing them the second time:

LARGE DENSIMETER.

Sample.	Number of lot.	Weights, pounds.	Number of hexagons.	Specific gravity.
Du Pont's hexagonal E. V. D	1	5	352¼	1.7661
	2	5	356¼	1.7678
	3	5	350¾	1.7654
	4	5	355½	1.7621
Average				1.7653

SMALL DENSIMETER.

First series.

Sample.	Number of lot.	Weights, grains.	Number of hexagons.	Specific gravity.
Dupont's hexagonal E. V. D	1	2987	30	1.7819
	2	2957	30	1.7592
	3	2910	30	1.7490
	4	2963	30	1.7501
Average				1.7600

SMALL DENSIMETER.

Second series.

Sample.	Number of lot.	Weights, grains.	Number of hexagons.	Specific gravity.
Du Pont's hexagonal E. V. D	1	2902	30	1.7660
	2	2990	30	1.7671
	3	3023	30	1.7755
	4	2972	30	1.7638
Average				1.7681

Mean result with large densimeter 1.7653
Mean result with small densimeter 1.7641

Owing to the considerable bulk of the sample employed with the large densimeter, and the comparatively large weights of powder and mercury that consequently enter the formula for the computation of the specific gravity, very close weighing with this instrument is not absolutely requisite. A variation, for instance, of 46 grains in the actual value of w, or of 350 grains in that of W′, would affect the resulting specific gravity by only two points in the third place of decimals. This feature is one of great practical utility, as it enables us to dispense with very small weights, and to abridge considerably the operations of weighing.

CHAS. S. SMITH,
Lieutenant of Ordnance.

OFFICE OF THE CONSTRUCTOR OF ORDNANCE, U. S. A.,
New York City, March 13, 1877.

Respectfully forwarded to the Chief of Ordnance, U. S. A., for his information.

S. CRISPIN,
Brevet Colonel U. S. A., Lieutenant-Colonel of Ordnance,
Constructor of Ordnance.

D.—*Fabrication of coiled wrought-iron gun-tubes at the West Point foundry.*

OFFICE OF THE CONSTRUCTOR OF ORDNANCE, U. S. A.,
New York City, January 13, 1877.

SIR: I have the honor to transmit herewith a report prepared, pursuant to my instructions, by Lieut. C. S. Smith, Ordnance Department, on the manufacture of bar-iron, and its subsequent fabrication into tubes intended for the conversion of 10″ Rodman smooth-bore guns into 8″ rifles, at the West Point foundry.

The report will be found to cover a complete description of the processes pursued.

Very respectfully, your obedient servant,

S. CRISPIN,
Brevet Colonel U. S. Army, Lieutenant-Colonel of Ordnance,
Constructor of Ordnance.

The CHIEF OF ORDNANCE, U. S. A.,
Washington, D. C.

Report on the fabrication of coiled wrought-iron tubes at the West Point foundry for conversion of Rodman 10″ *smooth-bore guns into* 8″ *rifles.*

OFFICE OF THE CONSTRUCTOR OF ORDNANCE, U. S. A.,
New York City, December 30, 1876.

SIR: Herewith I have the honor to submit a report, prepared at your request, on the fabrication of coiled wrought-iron tubes at the West Point foundry, for the conversion of 10″ Rodman smooth-bores into 8″ rifles, illustrating thereby the American as contrasted with the English mode of fabrication. That portion of the report touching the manufacture of the iron is, of necessity, cursory and but meager, inasmuch as a full knowlege upon that subject could only be sought upon the un-

derstanding that the information conveyed should be treated as "confidential."

Very respectfully, your obedient servant,

CHAS. S. SMITH,
Lieutenant of Ordnance.

Lieut. Col. S. CRISPIN,
United States Ordnance Department, Constructor of Ordnance.

MANUFACTURE OF THE BAR-IRON.

The bar-iron employed at the West Point foundry in the fabrication of tubes for gun-conversion is manufactured at the Ulster Iron Works, Saugerties, N. Y., an establishment which has long enjoyed a high reputation for the excellent quality of its iron. The pig from which the iron is produced is derived chiefly from the Lake Champlain magnetic ores, and from some of the hematite ores of Pennsylvania, the suitable proportions of kind and grade to yield a satisfactory metal being the result of much careful experiment.

The various operations of puddling, rolling, &c., differ in no particular respect from the ordinary methods employed, except in the greater care exercised to secure a high standard for the quality of the product. A brief notice here will therefore suffice.

The charge of pig-iron is first heated to redness by the waste heat from the reverberatory furnace, and is then thrown into the hearth along with a quantity of cinder. The charge consists of 448 pounds, the yield of blooms amounting to about 95 per cent. of the metal charged; the amount of coal consumed is 2,375 pounds per ton of puddle-bars, and the time occupied from the charging of the furnace to the withdrawal of the puddle-balls is about 1¾ hours.

The process in the furnace is what is termed the "boiling process," and the regulation of the draught during this period is an operation requiring great care and good judgment, as upon it the quality of the bar-iron will in great measure depend. It is important that the iron designed for gun-tubes shall not be too "dry," *i. e.*, deficient in cinder, as such an iron crumbles under a high heat, and, at best, welds but imperfectly. On the other hand, the presence of any considerable quantity of cinder indicates an insufficient "working," besides furnishing for the bore of the gun a material that is not sufficiently homogeneous and compact to resist well the eroding action of the powder-gases. The puddle-ball, under the action of the hammer, is formed into a bloom about 18″ long, by 4″ or 5″ square, and weighing about 100 pounds. The blooms, before cooling, are passed between the rollers—both "roughing" and "finishing"—and result in what are termed "muck-bars," long flat bars from 4″ to 2″ wide, and ⅝″ thick. The "muck-bars" are cut up and piled. The piles are then placed in the furnace and raised to a white heat, when they are subjected to a succession of rollings, by which they are converted into bars about 23′ long and ½″ thick. Each time, before being passed between the rollers, the piles are turned one-fourth round, so that the compression of the metal takes place in directions that are alternately parallel and perpendicular to the layers.

The operations of cutting, piling, and rolling are then repeated, and the resulting bar or plate cut into lengths of 53″, and piles made about 9½″ high by 7″ wide, for the final rolling. The top and bottom plates of these last piles are about ¾″ thick, while the intermediate plates are ½″ thick. At this stage, the piles are passed between the rollers, at first with the layers horizontal, but are afterward so manipulated that the corners of the piles shall take the groove in the rollers. The precaution is taken in heating the piles to separate slightly the successive layers,

in order that the heat may more readily penetrate the mass, and both in piling and rolling the iron, it is important that the direction of the fiber should be preserved always the same. In the finished bar the elementary plates stand parallel with the depth, the position most favorable to their final consolidation in the subsequent process of coil-welding. The length of the bar is about 23′, and the cross-section hexagonal in form, as shown in the following figure, to compensate for the changes in form incident to the process of coiling.*

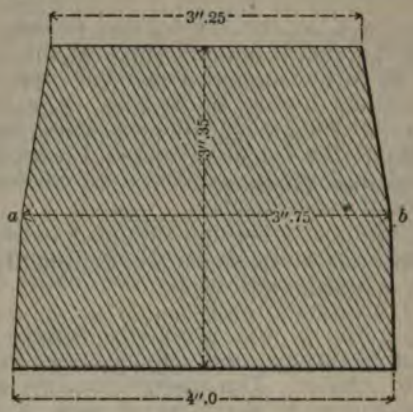


Figure I is the cross-section of the bar employed (Elswick) in the 8″, and Fig. II of the bar employed in the 12″ rifle-tubes.

FIG. II.

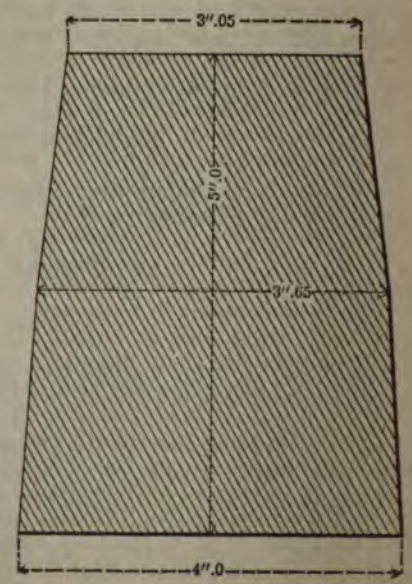
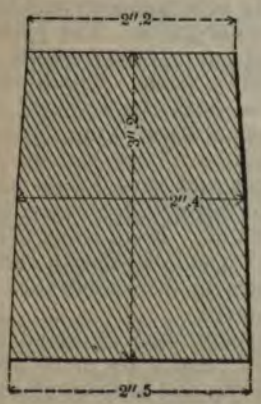


FIG. I.



Scale: half size.

*A bar of smaller cross-section than the above was employed at the "Elswick *Works*" in the manufacture of 8″ rifle-tubes for the United States. See next page.

By making the bar simply trapezoidal in cross-section, it was found that in coiling the sides become concave, thereby forming a pocket which, in the subsequent process of uniting the folds of the coil, served as a receptacle for cinder, and proved an obstacle to perfect welding. In order to avoid a feature so objectionable, the shoulders *a b* were added, whence a supply of metal can be drawn to fill up the cavity of the sides. The ends of the finished bar are cut off to where the material is thoroughly welded and perfectly sound, the greater length being taken from the end which was nearest the furnace-door, as being the colder end.

The bar is now ready for shipment to the foundry.

Specimens of this bar-iron have been subjected to mechanical tests at this office, for the purpose of ascertaining the physical properties of the metal, the detailed results of which are shown in the tables appended.

Following is a tabular comparison between the "Ulster" bar-iron and the "Ridsdale" bar-iron; the latter being that employed by Sir William Armstrong & Co., at the Elswick Works, in the fabrication of gun-tubes and coils.

Material.	Tensile strength, pounds per square inch.		Elongation per inch at breaking.		Elastic limit, pounds.		Density.	
	Ulster.	Ridsdale.	Ulster.	Ridsdale.	Ulster.	Ridsdale.	Ulster.	Ridsdale.
Bar-iron, (along its fiber) ..	52,000	52,534	0″.303	0″.299	22,500	24,000	7.664	7.690

REMARKS.—The above figures were determined by taking a mean of five tests of the Ulster and two of the Ridsdale iron.

The following analyses of samples of the same irons, made by Mr. Walter H. Hill, chemist of the naval torpedo station, have been kindly furnished this office by Commander F. J. Higginson, U. S. N., inspector of ordnance at the West Point foundry.

	Sample marked English.	Sample marked American.
Sulphur	0.047	0.037
Phosphorus	.....	Trace.
Manganese	0.374	1.228
Silicon	0.018	0.089
Slag and oxide of iron	1.308	2.144
Carbon	0.094	0.034
Iron	98.159	96.468
	100.000	100.000

The above tables exhibit a resemblance between the two varieties of iron which is remarkable, since the American manufacturers possessed no accurate knowledge of the mode of fabrication of the English iron, but were guided almost entirely in their efforts by such imperfect data as could be gleaned from reports of Parliamentary committees on the failure of a large number of coiled wrought-iron tubes in England; reports of which the chief value lay in their pointing out the nature of existing defects in material and manufacture, rather than the course of practice by which those defects might be removed or avoided.

FABRICATION OF THE TUBES.

The bar-iron, as received at the foundry, is in lengths of 16½′, and 18′ for the A tube, and of 26′ for the B tube, the cross-section of the latter being a square of 2⅝″ on a side. The weights are about as follows:

	Pounds.
Long bar for A tube	749
Short bar for A tube	678
Bar for B tube	608

The A tube is composed of four sections or short tubes welded together' each section, as well as the B tube, consisting of two bars, which are united, end to end, before coiling. The long bars for the A tube are employed in the breech section, in order to give that section such length that the joint between it and the next section shall be well in advance of the B tube.

WELDING THE BARS.

To prepare the bars for welding, they are sorted in pairs, and the ends to be united shaped as illustrated on Plate I for scarfing. At the same time, the other ends are tapered, by heating and hammering, and an eye and shoulder, *a b*, formed for purposes in coiling.

The V scarf, by affording a firm grasp to the ends, and by exposing a large surface for welding, is thought to insure a strong joint; yet, so great is the strain thrown upon the bar in the operation of coiling that separation does sometimes take place at that point.

The welding is readily performed by means of a "hollow fire" and an adjacent steam-hammer. The joint is subjected to three heats. At the first heat the bars are butt-welded by means of sledges; at the second and third heats the joint is lap-welded by the steam-hammer, the hexagonal cross-section being afterward restored by interposing a wedge-shaped tool between the bar and the hammer. While in the fire, one end of the bar abuts against a heavy timber, and the other end is repeatedly struck upon with a sledge to close and upset the joint.

COILING.

The coiling process is a familiar one, the method pursued at Cold Spring differing in no important respect from the English method. The heating-oven is shown on Plate II, in plan, section, and elevation, Figs. 1, 2, 3, and 4.

Total length of oven	78′ 3″
Height	30″
Width	42″

The grates and ash-pits, seven in number, are ranged along one side, and the draught enters under the grates. The blower is worked by the engine that revolves the coiling apparatus. The number of fires employed at any one time depends upon the length of the bars to be heated. About ninety bushels of anthracite coal a day are consumed in each grate. At the rear of the oven is a roller-way upon which the bars are moved into the oven. The slope of the oven and trestle-work facilitates the insertion of the bars; but, as a feature of the construction, it resulted rather from the inclination of the ground on which the oven is built than from design. The bars are pushed into the oven *as far* as it is possible to push them, and then a long iron hook is passed

in from the front and hooked into the eye in the end of the bar. A chain leading from the windlass of a steam-crane is connected with the hook, and the bar is drawn forward by the revolution of the windlass. It requires about three hours to heat the oven, and after that about one hour to heat the iron to a bright redness, the temperature required. The oven has a capacity for eight bars; but, to secure greater facility in handling, more than four are seldom heated at once.

The coiling apparatus is shown on Plate II, Fig. 5. *a* is a mandrel, slightly conical in form, on which the bar is wound; *b* is a roller-guide, over which the bar passes, and by means of which the exterior diameter of the coil is regulated; *c* is a sliding guide which regulates the spiral of the coil. At *d* is the steam-piston which communicates the motion. On the mandrel is an iron disk, *e*, through which is inserted a pin or key, *f*, and the end of the bar is attached to the mandrel by passing between it and the key, and hooking over the latter by means of the shoulder. In this position the narrow side of the bar is down or against the mandrel.

The apparatus having been put into gear, the mandrel revolves, winding the bar around it. To remove the coil, the apparatus is thrown out of gear, the cap-squares of the mandrel are removed, and, by means of the steam-crane standing immediately in rear, the mandrel is unshipped and swung round. The coil is then started by driving in wedges between the end of the coil and the disk *e*, after which it is readily removed.

After coiling, the cross-section of the bar is slightly concave on the exterior and convex on the interior of the coil, while the distances between the folds are less on the interior than on the exterior. It requires one hour to coil four bars.

WELDING THE COILS.

When removed from the mandrel, the ends of the bar project out from the coil, and the folds are very open, varying from $\frac{3}{4}''$ to $1\frac{1}{4}''$ on the exterior. The ends are therefore heated and hammered round to conform to the curvature of the coil. The next step is one of closing the folds and welding them. For these operations, there are provided two cast-iron tubes, banded with wrought-iron hoops, termed "welding pots," (Plate III, Figs. 1, 2, 3, and 4.) These pots are cylindrical without, but slightly conical within, and are of two sizes, the diameter of the smaller being $14\frac{1}{2}''$ and of the larger $14\frac{5}{8}''$ at bottom. In connection with the pots is used a short iron cylinder (Fig. 6) about 9″ in height and 14″ in diameter, termed the "cheese," which receives directly the impact of the hammer. The coil is at first heated to redness in an ordinary reverberatory heating-furnace, and then transferred, by means of a porter-bar suspended from a crane, to the smaller welding-pot, where it is simply pressed under the hammer. The effect of this operation is to close the folds along the surface of the bore. The porter-bar is provided with a heavy sliding counterpoise to facilitate handling it.

In order to avoid weak or imperfect welding of the folds, it is desirable that the process should commence at the interior surface of the coil and progress gradually outward, thus leaving to the last an open joint at the exterior for the escape of the cinder squeezed out in the operation. This end, it is thought, is secured by the particular form of cross-section given to the bar, and by the precaution taken of first closing the folds along the interior surface before proceeding to the welding.

The coil is now replaced in the furnace and subjected to a welding-heat, which occupies from $2\frac{1}{2}$ to 3 hours. It is then removed to the

smaller welding-pot, and the "cheese" dropped upon it, and hammered till the latter sinks to a certain mark chalked upon it. The pot is then turned over, and the coil withdrawn by means of blocks and tackle. The coil is then heated for the third time, and the same operation as above repeated, except that the larger pot is employed.

The length of the coil after closing the folds is about 4¼′, and the exterior diameter from 13″ to 13½″. After being withdrawn from the large pot, the length is about 3′; the exterior diameter about that of the pot, and the interior diameter from 5″ to 7″. The width of fold in the coils for the "A" tube is now about 2.75″, while in those for "B" tubes it is about 2″.

The hammer employed in welding the coils in an 8-ton steam-hammer.

On Plate IV, Figs. 1, 2, and 3, are illustrations of the coil at the following stages of its fabrication, viz: After being removed from the mandrel of the coiling apparatus, after the closing of the folds along the surface of the bore, and after the welding of the folds.

In England, the process of coil-welding differs as follows from the above: The coil having been subjected to a welding-heat, "it is placed vertically under the steam-hammer, and receives a few smart blows to weld the folds. It is then thrown on its side, and being gradually turned is hammered (or patted) all around to straighten it. It is then raised vertically again, and a punch or mandrel—rather over half the length and a little larger than the interior diameter of the coil—is hammered down its own length. The coil is next placed on its side and hammered round that half of its length, thus being made very compact, and large enough to let the mandrel fall out. After this, the coil is again raised vertical, and the mandrel is forced in the opposite end, and the process repeated. The reason a long mandrel is not forced through the whole length of the coil is that it would tend to separate the folds. The coil is replaced (upright) in the furnace for the second heating, and much the same process is followed to render the ring more consolidated as well as more shapely."

By the American process, there seems to be no tendency whatever to separate the folds during any part of the operation. The coil is withdrawn from the welding-pot by connecting the tackle with an iron rod, which passes down the interior of the coil, and is held by a key at the bottom, so that the strain is transmitted to that point.

WELDING THE SECTIONS.

After welding the folds, the coil is extremely rough and uneven on the interior; it is therefore removed to the shops, where it is rough-bored to within 0″.75 of the true diameter of the tube, which furnishes a straight and uniform bore for the formation of the tube. The exterior is comparatively smooth and cylindrical.

To unite two or more coils to form a tube, the ends are faced and reciprocally recessed; that is, a projection is formed at one end of a coil, while a recess is bored in the corresponding end of another coil. (See Plate III, Fig. 5.) The height of the projection is a little greater than the depth of the recess, in order that a close joint may be obtained on the interior. The recess is then expanded by heat and shrunk over the projection, so that the two coils are sufficiently stuck together to admit of being put into the furnace for welding. An iron rod, with a key at one end and a nut on the other, is passed through the sections, and the nut screwed up to prevent separation in shrinking.

The furnace for welding the sections is so constructed that an intense

heat shall act only upon the joint. The butt-welding is performed by means of a powerful screw-press. The furnace and welding apparatus are illustrated on Plate V. The tube is placed in the furnace by means of the crane and a porter-bar; the bars *a a* are then raised on the supporting-props *b*, the cross-head *c* and the screw *d* adjusted to the ends of the tube, and the wedges *e* inserted. The furnace is then entirely closed around the tube, and the draught turned on. It requires about three hours to raise the temperature of the metal on the interior of the tube to a welding-heat, a point which is ascertained by means of a hole pierced through the cross-head *c* and covered with a plate of mica, which permits of the interior of the tube being seen.

A welding-heat being obtained, the screw, which works in the cross-head *f* as a nut, is tightened by means of the handle *h*, till the tube is compressed lengthwise $\frac{1}{2}''$. The tube is then turned half around, the heat renewed for about ten minutes, and another turn given to the screw, by which a further compression of $\frac{1}{2}''$ is obtained. The props are then knocked out, the bars fall down, and the tube, which is considerably bulged at the joint by the compression it has undergone, is removed to the steam-hammer and "patted" into shape, as well as lap-welded. Sand is thrown on the joint during this operation, to protect the iron and prevent the formation of scale.

The face of the hammer, as well as the top of the anvil, is semi-cylindrical, to conform to the exterior of the tube.

Two sections being thus welded together,* another is added in a similar manner, and then another section which completes the tube.†

The furnace and apparatus for welding sections were devised by Mr. Colin Tolmie, superintendent of the forge-shops at the West Point foundry, and the experience so far had with them has been very satisfactory. The furnace has a capacity for about 1,500 pounds coal—anthracite coal being employed—and is so arranged as to consume its own gases. The amount of coal consumed in welding thirteen sections is about 6,900 pounds.

It requires ten hours to heat up the furnace when cold, and about four hours when working daily. The fire is always replenished during an interval when the tube is withdrawn, so as not to interfere with the heating. While in the furnace, should the joint become unequally heated, sand is thrown in upon the hotter part to equalize the temperature.

BORING, TURNING, &C.

The tube is now transferred from the forge to the shops, and placed in the lathe, where it is rough-turned and rough and fine bored. The breech-cup is then screwed in, the breech end of the tube turned down over a length of 32″ for the reception of the B tube, and the spiral gas channel cut upon it.

The breech-cup is a solid forging stamped into shape under the steam-hammer, turned inside and out, and screwed on the exterior with a thread of five to the inch.

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*After welding two sections together, a rule is applied, touching at points *a a*, Plate III, Fig. 5, equally distant from the axis, to ascertain if the tube is straight; if not, it is at once straightened before cooling.

†The English method of welding the sections is as follows: After shrinking two sections together, as above, "the tube is put crossways through a furnace so constructed that the heat acts only on the joint. When the joint arrives at a welding heat, a stout iron bar is passed through the tube; this bar is keyed up at one end, and by means of a screw-nut worked by a long lever at the other end, the two coils are welded or pressed together." The joint is afterward tapped under the hammer.

SPECIMEN No. 1—(WROUGHT IRON, P. K.)

Table showing the extension, restoration, and permanent set, caused by the under-mentioned weights per square inch of section, acting gradually upon a solid cylinder two (2″) inches long, between shoulders, and 0″.650 diameter, taken from a sample wrought-iron bar (4″ × 4″ in cross-section) along the fiber of the iron. Sample bar presented by Messrs. Paulding, Kemble & Co., of West Point foundry.

Weight per square inch of section.	Extension per inch in length.	First difference.	Restoration per inch in length.	First difference.	Permanent set per inch in length.	First difference.
Lbs.	*Inches.*		*Inches.*		*Inches.*	
1,500	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
3,000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
4,500	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6,000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
7,500	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
9,000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10,500	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12,000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
13,500	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
15,000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
16,500	0.00100	0.00000	0.00100	0.00000	0.00000	0.00000
18,000	0.00150	0.00050	0.00150	0.00050	0.00000	0.00000
19,500	0.00200	0.00050	0.00200	0.00050	0.00000	0.00000
21,000	0.00225	0.00025	0.00225	0.00025	0.00000	0.00000
22,500	0.00250	0.00025	0.00150	—0.00075	0.00100	0.00100
24,000	0.00275	0.00025	0.00125	—0.00025	0.00150	0.00050
25,500	0.00300	0.00025	0.00100	—0.00025	0.00200	0.00050
27,000	0.00350	0.00050	0.00125	0.00025	0.00225	0.00025
28,500	0.00500	0.00150	0.00200	0.00075	0.00300	0.00075
30,000	0.00550	0.00050	0.00125	—0.00075	0.00425	0.00125
31,500	0.00750	0.00200	0.00200	0.00075	0.00550	0.00125
33,000	0.00950	0.00200	0.00100	0.00100	0.00850	0.00300
34,500	0.01550	0.00600	0.00100	0.00000	0.01450	0.00600
36,000	0.02000	0.00450	0.00200	0.00100	0.01800	0.00350
37,500	0.02500	0.00500	0.00100	—0.00100	0.02400	0.00600
39,000	0.02800	0.00300	0.00150	0.00050	0.02650	0.00250
40,500	0.03400	0.00600	0.00250	0.00100	0.03150	0.00500
42,000	0.04000	0.00600	0.00275	0.00025	0.03725	0.00575
43,500	0.06150	0.02150	0.00750	0.00475	0.05400	0.01675
45,000	0.06450	0.00300	0.00800	0.00050	0.05650	0.00250
46,500	0.06650	0.00200	0.00350	—0.00450	0.06300	0.00650
48,000	0.06900	0.00250	0.00250	—0.00100	0.06650	0.00350
49,500	0.08650	0.01750	0.00200	0.00050	0.08450	0.01800
51,000	0.10200	0.01550	0.00200	0.00000	0.10000	0.01550
52,500	0.12550	0.02250	0.00300	0.00100	0.12250	0.02250
53,000	0.31100	0.18550	Specimen broke.			

Specimen No. 1.

Specific gravity	7.6810	Tensile strength per square inch	53,090 lbs.
Original diameter	0″.650	Total elongation	0″.6290
Diameter at point of rupture	0″.453	Length of specimen between shoulders	2″
Character of rupture	Fine, fibrous.	Position of rupture	Middle.

SPECIMEN No. 2—(WROUGHT IRON, P. K.)

Table showing the extension, restoration, and permanent set, caused by the under-mentioned weights per square inch of section, acting generally upon a solid cylinder two (2″) inches long, between shoulders, and 0″.650 diameter, taken from a sample wrought-iron bar (4″ × 4″ in cross-section) along the fiber of the iron. Sample bar presented by Messrs. Paulding, Kemble & Co., of West Point foundry.

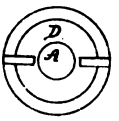
Weight per square inch of section.	Extension per inch in length.	First difference.	Restoration per inch in length.	First difference.	Permanent set per inch in length.	First difference.
Lbs.	*Inches.*		*Inches.*		*Inches.*	
1,500	0.0000	0.0000	0.0000	0.00000	0.0000	0.00000
3,000	0.0000	0.0000	0.0000	0.00000	0.0000	0.00000
4,500	0.0000	0.0000	0.0000	0.00000	0.0000	0.00000
6,000	0.0000	0.0000	0.0000	0.00000	0.0000	0.00000
7,500	0.0000	0.0000	0.0000	0.00000	0.0000	0.00000
9,000	0.0000	0.0000	0.0000	0.00000	0.0000	0.00000
10,500	0.0000	0.0000	0.0000	0.00000	0.0000	0.00000
12,000	0.0000	0.0000	0.0000	0.00000	0.0000	0.00000
13,500	0.0000	0.0000	0.0000	0.00000	0.0000	0.00000
15,000	0.0000	0.0000	0.0000	0.00000	0.0000	0.00000
16,500	0.0010	0.0000	0.00000	0.00000	0.0000	0.00000
18,000	0.0015	0.0005	0.00000	0.00000	0.0000	0.00000
19,500	0.0015	0.0000	0.00100	0.00000	0.0005	0.00000
21,000	0.0015	0.0000	0.00100	0.00000	0.0005	0.00000
22,500	0.0017	0.0002	0.00125	0.00025	0.00045	0.00005
24,000	0.0017	0.0000	0.00125	0.00000	0.00045	0.00000
25,500	0.0020	0.0003	0.00100	—0.00025	0.00100	0.00055
27,000	0.0025	0.0005	0.00150	0.00050	0.00100	0.00000
28,500	0.0030	0.0005	0.00150	0.00000	0.00150	0.00050
30,000	0.0035	0.0005	0.00100	—0.00050	0.00250	0.00100
31,500	0.0050	0.0015	0.00150	0.00050	0.00350	0.00100
33,000	0.0075	0.0025	0.00200	0.00050	0.00550	0.00200
34,500	0.0100	0.0025	0.00250	0.00050	0.00750	0.00200
36,000	0.0160	0.0060	0.00150	—0.00100	0.01450	0.00700
37,500	0.0270	0.0110	0.00250	0.00100	0.02450	0.01000
39,000	0.0265	0.0005	0.00250	0.00000	0.02400	—0.00050
40,500	0.0325	0.0060	0.00150	—0.00100	0.03100	0.00700
42,000	0.0355	0.0030	0.00100	—0.00050	0.03450	0.00350
43,500	0.0440	0.0045	0.00100	0.00000	0.04300	0.00850
45,000	0.0540	0.0100	0.00100	0.00000	0.05300	0.01000
46,500	0.0630	0.0090	0.00050	—0.00050	0.06250	0.00950
48,000	0.0780	0.0150	0.00250	0.00200	0.07550	0.01300
49,500	0.0995	0.0210	0.00200	—0.00050	0.09750	0.02200
51,000	0.1340	0.0345	0.00140	—0.00060	0.13260	0.03510
52,500	0.1850	0.0510	0.00250	0.00110	0.18250	0.04990
52,800	Specimen broke.	Absolute stretch, 0″.616.				

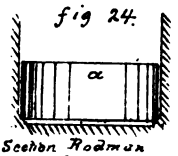
Specimen No. 2.

Specific gravity	7.6785	Total elongation	0″.616
Original diameter	0″.650	Length of specimen between shoulders	2″
Diameter at point of rupture	0″.468	Position of rupture	Middle.
Character of rupture	Fine, fibrous.	Elastic limit	19,000 lbs.

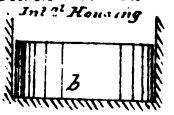
Tensile strength, 52,800 pounds per square inch.

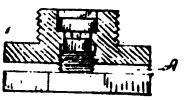
Crusher





Section Rodman Int.l Housing





LIEUT. METCALFE'S
INTERNAL-PRESSURE GAUGE
FOR CANNON

LEGEND.

FIG. 1.—Spiral pressure gauge, (1st form.) *a*, copper. *b* cutter: *c*, gas canal.
FIG. 2.—Same, with cap for high pressures.
FIG. 3.—Cross section, (Fig. 1.)
FIG. 4.—Cross section. (Fig. 2.)
FIG. 5.—Plan and section of spiral cutter.
FIG. 6.—Plan and section of copper
FIG. 7.—Hand vise for holding gauge while extracting copper, and for use in testing machine.
FIG. 8.—Compound implement—wrench two gas-check extractors, screw-driver and extracting screw.
FIG. 9.—Internal spiral gauge, (3d form.) *A*, cutter. *B*, copper. *C* body. *D* chamber section: *E*, breech screw; *f f* washers.
FIG. 11.—Section of breech of 4½" rifle with pressure gauge in position. Free end of bolt (*B*) drawn back.
FIG. 12.—Internal pressure gauge, with clamp. (last form.)
FIG. 13.—Rodman external bearing, with pressure gauge inserted.
FIG. 14.—Large internal spiral gauge, with increased area of copper for heavy pressures.
FIG. 15.—Section of spiral cutter (form abandoned.)
FIG. 16.—Section showing the offset of above shape or strength of cutter.
FIG. 17.—Section showing shape of chaser used in making cutting edge, giving them a bracing form.
FIG. 18.—Form of spiral for Fig. 14, (long edge.)
FIG. 19.—Form of spiral for Fig. 14, (short edge.)
FIG. 20.—Plan and section of protractor.
FIG. 21.—Housing for musket barrel, with Rodman external gauge.
FIG. 22.—Crusher gauge. *A*, gas check; *B*, plunger; *C* copper cylinder. *D*, housing; *E*, breech screw; *f*, washer.
FIG. 23.—Internal gauge, showing tried means of holding cutter in place.
FIG. 24.—Section Rodman internal housing, showing offset of not having square corners to bore.
FIG. 25.—Forms of spiral cutters. *a*, concave for high pressures; *b*, convex for low pressures.
FIG. 26.—Section showing the effect of a loose fit of the copper.

Accompanying Appendix (a), 1871.

Court of Claims for the purposes herein named; whereupon that court shall proceed and take full and complete jurisdiction of each and every matter contained in such verified petition or bill of complaint, in the same manner provided in section one of this act; and shall hear and determine the same, and all matters contained in the answer thereto, in the manner herein provided.

SEC. 3. That if either of the said several Departments have had, have, or shall have in use in the service and business of the United States, any improvements or invention upon which the letters-patent of said United States have been issued, the inventor and original patentee named in the letters-patent, or in any re-issue or any extension and renewal thereof, or any person or persons claiming to be the owner or owners of any interest in such letters-patent by a deed of assignment in writing, duly made and acknowledged before some officer having authority by law to take acknowledgments, and the same of record in the Patent-Office of said United States, the original deed of assignment so made and recorded, or a duly-certified copy thereof, being produced and made a part of the said petition of bill of complaint, may make the said United States defendants, and thus and thereby give the said Court of Claims the jurisdiction contained in section one of this act. The said petition or bill of complaint shall be in writing, and shall be the same, or substantially the same, as a bill in equity in the circuit court of the United States filed against an infringement of any letters-patent in that court, and shall set forth therein all the matters of fact which said Court of Claims is, by this act, required to pass upon and to determine at the final hearing of the case so referred or brought to the jurisdiction of said court, to which the Attorney-General of said United States shall make answer within thirty days next after service upon him of a duly-certified copy of the said petition or bill so made and filed with the clerk of said Court of Claims, and upon the filing of such answer with the clerk of said court, the issues shall be fully joined and the case ready for proofs, to be taken in the manner herein provided.

SEC. 4. That every such petition or bill of complaint shall be signed and sworn to by the petitioner or petitioners aforesaid before a United States commissioner, or a commissioner of said Court of Claims, or before a judge of a court of record having a seal; and the same shall also be signed by the attorney and counsel of record for the petitioner or petitioners in said Court of Claims; and in like manner the answer of the Government of said United States thereto shall be duly signed by the Attorney-General aforesaid in his official capacity. And after the filing of said answer in the manner hereinbefore stated and provided, eight days' notice, exclusive of the day of the service thereof, shall be given to said Attorney-General by said petitioner, or by the petitioner's attorney of record in said Court of Claims, of the time and place for the taking of such oral and documentary proofs as are intended to be used in such cause in support of the petition or bill of complaint so made and filed in said court, after which the said Attorney-General shall, in like manner, give notice of the time and place, and shall proceed to take such proofs as he may deem necessary in support of the answer so made and filed by him in the office of the clerk of said court. The proofs or evidence named as aforesaid may be taken by and before a United States commissioner or a commissioner of said Court of Claims, or an examiner in equity in the United States circuit court, in the usual manner, and under the same rules as now practiced in patent causes in the said circuit court. After the direct and rebuttal proofs upon each side in any such cause have been taken and filed in the office of the clerk of

said Court of Claims, such cause shall be deemed to be ready for argument and final hearing, and thereupon the same shall be put upon the current calendar or trial-docket of said court for such hearing and argument upon the evidence so taken and submitted by both the parties named in the petition or bill of complaint, or by either party thereto upon the default of the other or refusal to take proofs as herein provided; and the same shall then be proceeded with by that court to final judgment and decree in the usual manner established by said court with reference to the making and entering of final decrees and judgments.

SEC. 5. That the said Court of Claims shall fix upon and decree the rate of compensation, and the sum or amount of money to which the aforesaid inventor and original patentee, or his heirs, or assigns, or legal representative may, upon the proofs, be entitled to have and to receive in the manner claimed in and by such petition or bill of complaint so made and filed in said court, and up to the time of adjudication by said Court of Claims; all of which shall be heard and determined upon the evidence taken and submitted to said court in the manner substantially as hereinbefore provided.

SEC. 6. That any three of the judges of said Court of Claims may, upon the written application of either party named as aforesaid, regulate, by an order in writing, duly signed by them, the time, place, and the manner for the taking of proofs or evidence to be used upon either or both sides in any cause brought within this act into said court in the manner aforesaid, so as to prevent unnecessary expense or delay by either party aforesaid; but due notice thereof shall first be given to the adverse party, and said application may be heard in open court, or at the chambers of the chief-justice of said court; and in like manner upon the written application of either party, such judges may determine upon the time for the trial or final hearing and argument of any such cause so brought into said court.

SEC. 7. That if any person or persons claiming to own the whole or a part interest of the right and title to the invention and letters-patent thereon, by a good and valid deed of an assignment, made, executed, and of record in the manner hereinbefore made and provided, if there be any, who are not joined in such petition or bill aforesaid, shall be made party defendants therein with the said United States and brought into said Court of Claims, or required therein to appear, upon such notice or order as the said court shall determine and direct; and thereupon the said Court of Claims shall have the same jurisdiction of each and every matter thereof as it has herein and hereby with reference to said inventor and original patentee, and shall hear and determine the same in the manner and with the same force and effect as hereinbefore provided.

SEC. 8. That if in any cause made and filed in the said Court of Claims, in the manner as provided for by this act, anybody shall have a good, sufficient, and valid deed of assignment and transfer of the invention and letters-patent named in the petition or bill of complaint aforesaid, or of any part thereof, and if the same be of record in the United States Patent-Office as by law required, the same, if required, or a duly-certified copy thereof, shall be produced in evidence in said Court of Claims by the person or persons holding and owning it, for the inspection and opinion and judgment of said court thereon; and thereupon the said court shall have full jurisdiction of the same and of all matters appertaining thereto, and may, upon evidence duly taken as hereinbefore provided, proceed to hear such cause, and to determine each and every

matter that may be at issue or involved in or by the evidence so taken and presented concerning such deed of assignment, and to whom any judgment that may be rendered, decreed, or ordered to be entered against said United States shall be paid; and in case an appeal be taken, in the manner provided for in and by section twelve of this act, to the Supreme Court of the said United States, then that court may, in like manner, determine such matter and to whom the said United States shall pay any judgment so made, decreed, and entered by said Court of Claims. But if no such deed of assignment or a duly-certified copy thereof be offered and received in evidence in such cause before the closing of the direct or redirect evidence upon either side therein, then such cause shall be proceeded with and heard and determined by said court in the manner hereinbefore made and provided. Any person who may have any knowledge or evidence concerning the matters involved in the petition or bill aforesaid, or in the answer thereto, may be examined as a witness, by and in behalf of the parties to such suit, or either of them.

SEC. 9. That any proofs or evidence taken in pursuance of the provisions contained in this act shall be duly certified to by the officer before whom and by whom the same is taken, and thereupon the same shall be securely sealed up by such officer, and by him transmitted to the clerk of said Court of Claims, in the same manner as now practiced in the said circuit court of the United States, or as required by the rules of practice in said Court of Claims, which shall be done within thirty days next after the taking of the same as aforesaid is completed. Duly-certified copies of any record-papers, other than that of deeds of assignment, or transfers, or licenses, may be used in evidence in any such cause in said court in the same manner and with the same effect as other evidence is used in or by said Court of Claims.

SEC. 10. That if such letters-patent have been renewed or extended by the Commissioner of Patents or by an act of Congress, or if the same have been re-issued either before or after any renewal or extension thereof, the jurisdiction of said Court of Claims, conferred by this act, shall apply to the same; and the right of recovery against said United States as herein provided for the use of the invention so patented, or re-issued, or renewed and extended, shall be under either the original letters-patent or any re-issue thereof, or under any renewed and extended term of the same; and the same, and each and every thereof, may be included in the same petition or bill of complaint, and the compensation for the use of the invention so patented shall be fixed and determined upon the length of time the same has been used in the public service by the direction of either of the Departments, or any officer named in section one of this act.

SEC. 11. That in case of the decease of said inventor and original patentee, or of any such assignee, either before are after the filing of any such petition or bill of complaint as aforesaid, then his administrator or executor, or administratrix or executrix, for the benefit of the heirs and estate of such deceased inventor and patentee, or of such assignee, shall be deemed, and shall be, the rightful and lawful party against said United States for all and every of the purposes mentioned and provided for in this act, and may prosecute the same to final judgment and decree in either or both of said courts; and shall be responsible and accountable to such estate therefor, in the same manner as provided by law in the State where such estate shall be situated at the time of the decease of such inventor and patentee, or assignee.

SEC. 12. That either party aforesaid may appeal to the Supreme

Court of said United States within thirty days next after judgment or final decree shall have been made and ordered by said Court of Claims as hereinbefore provided; such cases, so appealed, to be preferred causes in said court; and if the said judgment or final decree shall not be appealed, or if appealed, and the said judgment or final decree shall be affirmed by said Supreme Court, then the same shall be certified by the said Court of Claims to the Secretary of the Treasury of said United States in the same manner as now provided by the law in relation to any other judgment of said Court of Claims; and the same, when presented to the Secretary of the Treasury aforesaid, shall have the same effect as now provided by law, and shall thereupon be paid out of any general appropriation in relation to judgments of said Court of Claims or for private claims; and the payment of such judgment shall be in full satisfaction for all claims for compensation for the use of such patented invention or improvements up to the time of the making and entering of such judgment or decree thereon by the said court, and no longer; or such judgment may be paid by the Secretary of the Treasury of said United States out of any money in the said Treasury not otherwise appropriated, with the same effect as though the same had been paid out of any money appropriated for the payment of judgments of said Court of Claims or for private claims.

SEC. 13. That this act shall take effect immediately after its passage and approval.

Extract from annual report of Chief of Ordnance for 1875 *on infringement of patents.*

I have the honor again to advert to the subject of patent-claims set up against this Department for alleged infringements in the productions at the national armory and at the several arsenals of construction. The Chief of Ordnance, in his report for the year 1873, gave a succinct statement of the state of those claims at that time The claims on the Springfield rifle date back to the order of the Secretary of War of July 28, 1866, for the conversion of 50,000 muzzle-loaders to breech-loading arms. The skill and ingenuity of the officers and workmen of the Ordnance Department, brought into active operation previous to that time and continued to the present, have resulted in the production of as perfect a single breech-loading arm as will find its place in modern war. Its mechanism, it is claimed, has touched upon and appropriated in part the best features of several distinct and separate patents, some of which were perfected and re-issued after the work of the Government had begun, and whose owners are now seeking compensation for the use.

The consideration of a patent-case involves a careful weighing of many matters of fact relating to novelty, priority, &c., as well as an appreciation of equivalents and dissimilarities in mechanical structures and contrivances, and the proper application of the principles of patent law to facts thus found. Where a device stands boldly out as the original type of its class, and the many questions of a character to affect the validity of the patent are in such a case reasonably free from doubt, it is apprehended that it would require but ordinary patent-expert skill to settle with certainty the merits of any question of infringement that might be raised; but where *several* claimants profess to cover by their patents the same identical device or combination, a proper regard to the several interests involved renders the matter more difficult of determination. An impartial settlement requires, in most cases, the assist-

ance of the highest degree of expert-skill and the exercise of the highest order of legal talent in the specialty of patent law. The law prescribes a judicial method of settlement where private parties only are concerned, but the means of deciding properly between contending patentees and determining the amount of damages sustained by them, or any of them, where the Army workshops are concerned, are not vested in any portion of this Department, nor, indeed, as respects cases wherein the United States are properly the defendants, are they known to be vested in any department of the Government at the present time.

The methods adopted by some of the claimants, of instituting suits in the United States circuit courts against officers of this Department for the alleged infringements, is onerous to the officers themselves, and can only result, in the event of the success of the suits, in embarrassing such officers in their private means, whereas the Government is the sole beneficiary in the use of the things which are the subject-matters of litigation. A recent opinion of the Attorney-General has inferentially decided that the executive officers of the Government are not authorized to settle the judgments, for past use, rendered in such suits without authority of Congress to do so. This opinion has been the guide of this bureau since that time. The officers, therefore, against whom judgments might be rendered would be put to the harassing necessity of securing special legislation for their relief in respect to matters over which they have had little or no power or control.

The indemnity due to public officers who have acted in pursuance of competent authority in the performance of their public duty, or who have in good faith exercised the discretion vested in them by law, is secured to a certain class of Government officials by general legislation. Collectors and other officers of the revenue are thus secured by section 989, Revised Statutes. It is therein enacted, that when a recovery is had in any suit or proceeding against such officer for any act done by him in the performance of his official duty, and the court certifies that there was probable cause for the act done by him, or that he acted under the direction of the Secretary of his Department, or other proper officer of the Government, no execution shall issue against him, but the amount so recovered shall, upon final judgment, be provided for and paid out of the proper appropriation from the Treasury. *Legislation similar to the foregoing, in favor of the officers of this Department* against whom recoveries may be had for infringement of patents in the productions of the armory and arsenals, would be a practicable method of relieving this bureau of a present embarrassment.

It is believed, however, that, where several patents are alleged to cover a single complex device, each of these patents should be brought under the adjudication of a *common* tribunal, where the combined wisdom and experience necessary to the disposal of the whole number of cases could be brought to bear on each particular one in detail. If suits on such a device are brought by the several patentees in widely-separated jurisdictions, there is great liability of undue compensation being awarded to one patentee and inadequate remuneration to another, when the relative importance of the several patents is thereafter taken into account.

It is, therefore, a question in the interest of the patentees themselves, as well as of public economy, whether some particular forum should not be named wherein claims of the character here referred to should be exclusively brought. The Court of Claims has denied its jurisdiction in cases of infringement of patent-rights by the Government, because such claims are held to sound in *tort*, and because the jurisdiction of the circuit courts is by law made exclusive in cases of patents. (See Pitcher's case,

and Nock's case, 1 C. C. Repts., pp. 7 and 83.) Were it not, therefore for these limitations upon the jurisdiction of the Court of Claims, this Department might readily refer all cases of alleged infringement for the decision of that tribunal under section 1063 of the Revised Statutes. Claimants before this bureau for past use are now, however, without a remedy, except by personal actions against the officers of the Ordnance Department (who have been and are acting under superior authority) or by a direct application to Congress. As indicating the direction heretofore given by Congress to a complicated patent-case arising out of this bureau, in order to secure for it the careful legal investigation which its importance demanded, attention is respectfully invited to the joint resolution of June 3, 1864, (13 S. L., p. 588,) referring the claim of William W. Hubbell to the Court of Claims. This claim was founded upon the use by the Government, to a very large extent, of devices covered by the patents of the claimant; and the court was directed to investigate and determine whether the claimant was the original inventor of the particular devices in question, and if he had a just and equitable right to compensation for the same; if so, what amount of compensation he was entitled to receive for the use of the inventions up to the time of adjudication, and for a full and entire transfer of his patents to the United States. This case, therefore, furnishes a precedent for the method of settling this class of cases; and, coupled with the advantages to accrue from the adjudication in a single tribunal of all patents where the United States is defendant, I would respectfully submit it to the wisdom of Congress *whether jurisdiction ought not to be given to the Court of Claims in all cases of the character here explained where the United States is defendant.* I earnestly recommend that some action may be taken at the coming session on this subject, which has engaged the attention of this bureau for so long a time.

Letter of Chief of Ordnance relating to the infringement of patents.

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, October 11, 1875.

SIR: I have the honor to submit the propriety of soliciting from the Attorney-General his concurrence in an effort which I request may be made to secure from Congress the passage of an act authorizing this Department, whenever the public interest may demand it, to prosecute in the National Armory and the arsenals of construction the manufacture of articles of ordnance destined for public use in the military service, without regard to any patent-rights granted by the Government, and prescribing a judicial method of awarding compensation from the Treasury to holders of patents, and upon their making it to appear in a proper tribunal that their letters-patent, being valid, are the subject of infringement by this Department, and showing the amount of compensation to which they are reasonably entitled.

The reasons which prompt me to make this request are the following:

Upon directions being given by the Secretary of War to this bureau, any article of ordnance whatever must, by the rules of the military service, be purchased or manufactured in the public workshops of the armory and arsenals, if the appropriations for this branch of the service will permit the expenditure. Where machinery adequate to the production of articles ordered is not on hand, it also has to be purchased or manufactured as above.

It is out of these manufactures by the United States that much difficulty has arisen to this bureau during the past few years; difficulties resulting from actual or supposed infringement of patent-rights held by private inventors, or by persons or corporations who have become the assignees of such rights.

Without attempting to enumerate all the instances that have occurred or may occur in this Department, it may be stated generally that few departures from known devices can be made in the Government workshops without originating a demand against the Department for allowance of royalty for infringement of letters-patent. The class of war materials, like all other classes, is open to all the world for improvement; a not inconsiderable portion of the world avails itself of the opportunity, and this whole field of invention is overlaid with the paper-grants of the Government under the laws for promoting the progress of science and the useful arts.

Did a patent granted by the Government convey *per se* an incontestable right to remuneration for any invasion of the same, one element of difficulty would be obviated in the consideration of questions relating to infringement; but as the granting of a patent or a reissue by the Patent-Office is a mere ministerial act, not professing to be a warranty of the franchise conferred, the recognition of such act as conclusive in any given case must be made in the face of all the possible infirmities which may inhere in it. That radical and fatal infirmities do exist in numbers of cases the records of adjudications of patent cases in the courts will amply attest. Where, therefore, controversies are raised between owners of patents in which this Department may be considered as an infringer, it is manifestly not in the province of the Department to settle contending rights, as the judicial machinery necessary to that end is nowhere vested in it. Meanwhile, however, the Department continues the manufacture or use, without the power to decide whose claim before it is the most meritorious.

Nor is there any plain, adequate remedy provided by law whereby claimants can obtain remuneration from the Government. The infringement of a patent has been held to partake of the nature of a *tort* on the part of the individual infringer; it has been so held by the Court of Claims in Pitcher's case and Nock's case, (1 C. C. Repts., pp. 7 and 83,) and in the case of Ely *vs.* Benton, which was before the United States circuit court for the district of Massachusetts in 1871. The question whether or not the commanding officer of the National Armory was personally answerable in damages to the owner of a patent infringed in the manufactures under his direction at the armory was reserved on division for the decision of the United States Supreme Court. The question was never pressed before the Supreme Court, and may therefore be considered as yet an open one. *It is for the settlement of this question, as well as for providing a method of remuneration from the Treasury to meritorious patentees, that legislation is now asked.* The United States is the real beneficiary of the acts of its agents at the armory and arsenals, who can only act in obedience to the superior authority of the War Department.

Where manufactures or use by the United States have continued for any length of time without the consent of the holder of a patent, it has been held by the Attorney-General that no award of public moneys as damages can be made to such holder of patent without authority of Congress; the infringement being in the nature of a damage, which an executive officer is not authorized to adjudicate upon.

Were there no other difficulties to be encountered in the settlement

of these patent cases, the single question of "measures of damage
would take each case out of the jurisdiction of this Department.

As before suggested, there is no judicial process under the control
this Department by means of which the proper damages to be allow
may be estimated or determined. Between private parties actions
infringement may be either at law or in equity. At law, "actual" da
ages alone are allowed, and these are to be found through the inst
mentality of *a jury*, and are subject to be trebled by the judge at
discretion in favor of the party whose right is infringed. And it h
been held, (16 How., 480,) that "actual damages must be actually prov
and cannot be assumed as a legal inference from any facts which amo
not to actual proof of the facts." In equity, besides the profits that m
have accrued to the infringer, the complainant is entitled to recover t
damages he has sustained, subject to being trebled, as at law, and
court is authorized to assess the damages or cause the same to be
sessed. From the judgment or decrees in either form of action appe
are provided in the ordinary course of judicial procedure. A sim
glance at these methods of settlement of cases of infringement betwe
individuals, therefore, will show the inability of an executive officer (w
is not invested with judicial functions, and from whose judgment
judicial appeal in such cases is provided) to settle patent cases when
the United States is concerned.

In the absence of any better method of disposing of the cases wh
have accrued in this bureau, it has been the custom to refer them
the Department of Justice, with the request that an opinion might
expressed upon the validity of the patents, and that a method of sett
ment might be suggested. In one instance, the papers, after an opini
had been furnished by the Department of Justice, were referred to
officer of ordnance, familiar with the subject-matter of the patents,
an opinion upon the amount of damages. Some of the cases are s
pending in the Department of Justice.

Upon recent reflection I have arrived at the conclusion that the meth
adopted in these cases is not the best for subserving the individu
interests of the claimants and of the Government, and the Departme
is powerless to afford relief in any case without the action of Congre
As this power has, in any event, to be invoked, I would recomme
that general legislation be asked so as to cover all the cases. This c
best be done by designating some special tribunal wherein actions m
be brought against the Government for alleged infringement in the wo
shops and in the products of the Ordnance Department. My views
this regard are embraced in the inclosed extract from my annual rep
of this year, and the measure therein suggested is the one which I wou
earnestly ask may be submitted to the Attorney-General for his inf
ence and support, if it should commend itself to his judgment.

I have the honor to be, very respectfully, your obedient serva

S. V. BENÉT,
Brig. Gen., Chief of Ordnance.

The Hon. SECRETARY OF WAR.

[S. 571.—Forty-fourth Congress, first session.]

[Report No. 467.]

IN THE SENATE OF THE UNITED STATES, *July* 15, 1876.—Ordered to be printed.

Amendment reported by Mr. Wadleigh, from the Committee on Patents, to the bill (S. 571) extending the jurisdiction of the Court of Claims of the United States, and for other purposes, viz: Strike out all after the enacting clause and insert the following:

That if the Secretary of War, or of the Navy, or of the Treasury, or of the Interior Department, or the Postmaster-General, or any other officer of the United States, acting under authority from the head of any Executive Department, or of any bureau of the said several Departments of the Government of said United States, has used, or shall hereafter use, in the public service, any invention upon which the letters-patent of said United States have been issued, or re-issued, or extended and renewed whereby, and by means of which, such service has been, or is, improved or benefited, either in the saving of labor or in the reduction of expenses in the management of Government affairs, or if such service has been, is, or shall be in any other way or manner improved or benefited, the Court of Claims of the United States is now and hereby vested with full and exclusive jursidiction in and over any and all such cases, the same to be brought into and before said Court of Claims, by a petition or bill of complaint verified and filed in said court, in the manner and for the purposes herein provided, and whose duty shall be to hear, investigate, and determine any and all such cases submitted to said court, upon pleadings and proofs, in the manner herein provided for it to hear, investigate, and determine, and involving the following questions of fact for the consideration and judgment of said court, to wit:

First. The granting and issuing of the letters-patent, or of any re-issue or extension and renewal thereof, each of which shall be set forth by date and number, and described in the petition or bill of complaint filed in said court in the manner substantially as hereinafter provided; and also the validity or the invalidity of such letters-patent, or of any re-issue or extension and renewal thereof, with the same jurisdiction and power that the circuit court of the United States now has over and upon such matter or such questions of fact;

Second. The use of the improvements, invention, and letters-patent thereon in the business and service of said United States, and in what Department, and for what purpose used, and the extent of that use within the life-time or duration of the grant of the letters-patent upon which such petition or bill of complaint is founded, as herein required and provided;

Third. The compensation or sum of money to be paid by said United States, upon the evidence submitted, for such use of the improvements, invention, and letters-patent so applied to the public service; and,

Fourth. The right, title, and ownership of the letters-patent specified in the petition or bill of complaint in the manner aforesaid; and to whom the compensation for such use of invention and letters-patent thereon shall be awarded and paid by said United States.

SEC. 2. That if either of the said several Departments have had, have, or shall have in use in the service and business of the United States, any improvements or invention upon which the letters-patent of said United States have been issued, the inventor and original patentee named in the letters-patent, or in any re-issue or any extension and

renewal thereof, or any person or persons claiming to be the owner or owners of any interests in such letters-patent by a deed of assigment in writing, duly made and acknowledged before some officer having authority by law to take acknowledgments, and the same of record in the Patent-Office of said United States, the original deed of assignment so made and recorded, or a duly-certified copy thereof, being produced and made a part of the said petition or bill of complaint, may make the said United States defendant, and thus and thereby give the said Court of Claims the jurisdiction contained in section one of this act, upon the filing of a duly-verified petition or bill of complaint, as herein provided, in said court, and serving the Attorney-General with a duly-certified copy of the same so filed by the petitioner or complainant. The said petition or bill of complaint shall be in writing, and shall be the same, or substantially the same, as a bill in equity in the circuit court of the United States filed against an infringement of any letters-patent in that court, and shall set forth therein all the matters of fact which said Court of Claims is, by this act, required to pass upon and to determine at the final hearing of the case so referred or brought to the jurisdiction of said court, to which the Attorney-General of said United States shall plead or make answer within thirty days, or such time as said court may fix upon, next after service upon him of a duly-certified copy of the said petition or bill so made and filed in the said Court of Claims; and upon the filing of such plea or answer in said court, the issues shall be fully joined and the case ready for proofs, to be taken in the manner herein provided. And among other defenses which the said Attorney-General may make for and on the part and behalf of said United States, by plea or answer to such petition or bill of complaint, he may make the following special defenses, to wit:

In any action for infringement, the defendant may plead the general issue, and having given notice in writing to the plaintiff or his attorney thirty days before, may prove, on trial, any one or more of the following special matters:

First. That for the purpose of deceiving the public the description and specification filed by the patentee in the Patent-Office was made to contain less than the whole truth relative to his invention or discovery, or more than is necessary to produce the desired effect; or,

Second. That he had surreptitiously or unjustly obtained the patent for that which was in fact invented by another, who was using reasonable diligence in adapting and perfecting the same; or,

Third. That it had been patented or described in some printed publication prior to his supposed invention or discovery thereof; or,

Fourth. That he was not the original and first inventor or discoverer of any material and substantial part of the thing patented; or,

Fifth. That it had been in public use or on sale in this country for more than two years before his application for a patent, or had been abandoned to the public.

And the said United States may plead the same defenses in any action brought under this act as are allowed to be pleaded by any defendant in any action or in any suit for infringement in the United States circuit court under existing laws: *And it is hereby provided*, That in case where the validity of a patent has been sustained or overthrown in the circuit court of the United States, in an action at law, or in a suit in equity, between private parties, the transcript of the proceedings thereof in such court, being duly certified, and put in evidence upon due notice to the adverse party, shall have the same weight and force in said Court

of Claims as the decisions of one court now have in another of similar jurisdiction.

SEC. 3. That every such petition or bill of complaint shall be signed and sworn to by the petitioner or complainant aforesaid before a United States commissioner, or a commissioner of said Court of Claims, or before a judge of a court of record having a seal; and the same shall also be signed by the attorney and counsel of record for the petitioner or complainant in said Court of Claims; and, in like manner, the plea or answer of the Government of said United States thereto shall be duly signed by the Attorney-General aforesaid in his official capacity. And after the filing of said plea or answer in the manner hereinbefore stated and provided, fifteen days' notice, exclusive of the day of the service thereof, shall be given to said Attorney-General, by said petitioner or by the petitioner's attorney of record in said Court of Claims, of the time and place for the taking of such oral and documentary proofs as are intended to be used in such cause in support of the petition or bill of complaint so made and filed in said court, after which the said Attorney-General shall, in like manner, give notice of the time and place, and shall proceed to take such proofs as he may deem necessary in support of the plea or answer so made and filed by him in the office of the clerk of said court. The proofs or evidence named as aforesaid may be taken by and before a United States commissioner, or a commissioner of said Court of Claims, or an examiner in equity in the United States circuit court, in the usual manner, and under the same rules as now practiced in patent causes in the said circuit court. After the direct and rebuttal proofs upon each side in any such cause have been taken and filed in the office of the clerk of said Court of Claims, such cause shall be deemed to be ready for argument and final hearing; and thereupon the same shall be put upon the current calendar or trial docket of said court for such hearing and argument upon the evidence so taken and submitted by both the parties named in the petition or bill of complaint, or by either party thereto, upon the default of the other, or refusal to take proofs as herein provided; and the same shall then be proceeded with by that court to final judgment and decree in the usual manner established by said court with reference to the making and entering of final decrees and judgments.

SEC. 4. That the said Court of Claims shall fix upon and decree the rate of compensation, and the sum or amount of money to which the aforesaid inventor and original patentee, or his heirs or assigns, or legal representative, may, upon the proofs, be entitled to have and to receive in the manner claimed in and by such petition or bill of complaint so made and filed in said court, and up to the time of adjudication by said Court of Claims; all of which shall be heard and determined upon the evidence taken and submitted to said court in the manner substantially as hereinbefore stated: *Provided*, That the rate of compensation and the sum awarded by the court shall, in all cases admitting of such computation, be computed upon the basis of a reasonable royalty due for the use of the claimant's right; and in no case shall the sum so awarded exceed the profit or benefit derived by the United States from the use of such right.

SEC. 5. That any one of the judges of said Court of Claims may, upon the written application of either party named as aforesaid, regulate, by an order in writing, duly signed by him, the time, place, and the manner for the taking of proofs or evidence to be used upon either or both sides in any cause brought within this act into said court in the manner aforesaid, so as to prevent unnecessary expense or delay by either party aforesaid; but due notice thereof shall first be given to the adverse

party, and said application may be heard in open court, or at the chambers of the judge before whom said application is made; and in like manner, upon the written application of either party, said court may determine upon the time for the trial or final hearing and argument of any such cause so brought into said court.

SEC. 6. That any person or persons claiming to own the whole or a part interest of the right and title to the invention and letters-patent thereon, by a good and valid deed of an assignment, made, executed, and of record in the manner hereinbefore made and provided, or otherwise claiming any interest therein, who are not joined in such petition or bill aforesaid, may be made party defendants therein with the said United States, and brought into said Court of Claims, or required therein to appear upon such notice or order as the said court shall determine and direct; and thereupon the said Court of Claims shall have the same jurisdiction of each and every matter thereof as it has herein and hereby with reference to said inventor and original patentee, and shall hear and determine the same in the manner and with the same force and effect as hereinbefore provided.

SEC. 7. That if in any cause made and filed in the said Court of Claims, in the manner as provided for by this act, anybody shall have a good, sufficient, and valid deed of assignment and transfer of the invention and letters-patent named in the petition or bill of complaint aforesaid, or of any part thereof, and if the same be of record in the United States Patent-Office, as by law required, the same, if required, or a duly-certified copy thereof, shall be produced in evidence in said Court of Claims, by the person or persons holding and owning it, for the inspection and opinion and judgment of said court thereon; and thereupon the said court shall have full jurisdiction of the same, and of all matters appertaining thereto, and may, upon evidence duly taken, as hereinbefore provided, proceed to hear such cause, and to determine each and every matter that may be at issue or involved in or by the evidence so taken and presented concerning such deed of assignment, and to whom any judgment that may be rendered, decreed, or ordered to be entered against said United States shall be paid; and in case an appeal be taken in the manner provided for in and by section twelve of this act, to the Supreme Court of the said United States, then that court may, in like manner, determine such matter, and to whom the said United States shall pay any judgment so made, decreed, and entered by said Court of Claims. But if no such deed of assignment, or a duly-certified copy thereof, be offered and received in evidence in such cause before the closing of the direct or redirect evidence upon either side therein, then such cause shall be proceeded with, and heard and determined, by said court in the manner hereinbefore made and provided. Any person who may have any knowledge or evidence concerning the matters involved in the petition or bill aforesaid, or in the plea or answer thereto, or any part thereof, may be examined as a witness by and in behalf of the parties to such suit, or either of them. And any and all persons now allowed to testify as a witness in patent or other causes in the circuit court of the United States shall be competent to testify and render evidence in said Court of Claims in any suit brought under this act, and in behalf of either party thereto.

SEC. 8. That any proofs or evidence taken in pursuance of the provisions contained in this act shall be duly certified to by the officer before whom and by whom the same is taken; and thereupon the same shall be securely sealed up by such officer, and by him transmitted to the clerk of said Court of Claims, in the same manner as now practiced

in the said circuit court of the United States, or as required by the rules of practice in said Court of Claims, which shall be done within twenty days next after the taking of the same as aforesaid is completed. Duly certified copies of any court or other record-papers, other than that of deeds of assignment, or transfers, or licenses, may be used in evidence in any such cause in said court in the same manner and with the same effect as any other evidence is used in or by said Court of Claims, or by the circuit court of said United States.

SEC. 9. That if such letters-patent have been renewed or extended by the Commissioner of Patents or by an act of Congress, or if the same have been re-issued either before or after any renewal or extension thereof, the jurisdiction of said Court of Claims, conferred by this act, shall apply to the same; and the right of recovery against said United States as herein provided for the use of the invention so patented, or re-issued, or renewed and extended, may be under either the original letters-patent or any re-issue thereof, or under any renewed and extended term of the same; and the same, and each and every thereof, may be included in the same petition or bill of complaint, and the compensation for the use of the invention so patented shall be fixed and determined upon the length of time the same has been used in the public service by the direction of either of the Departments, or any officer named in section one of this act: *Provided*, That the invention or improvement so patented shall have been used in the public service, in the manner hereinbefore stated, under either the original, or re-issued, or extended and renewed letters-patent.

SEC. 10. That in case of the decease of said inventor and original patentee, or of any such assignee, either before or after the filing of any such petition or bill of complaint as aforesaid, then his administrator or executor, or administratrix or executrix, for the benefit of the heirs and estate of such deceased inventor and patentee, or of such assignee, shall be deemed, and shall be, the rightful and lawful party against said United States for all and every of the purposes mentioned and provided for in this act, and may prosecute the same to final judgment and decree in either or both of said courts, and shall be responsible and accountable to such estate therefor, in the same manner as provided by law in the State where such estate shall be situated at the time of the decease of such inventor and patentee or assignee.

SEC. 11. That hereafter the district or circuit courts of said United States shall not have or take jurisdiction over or against any officer or person in the service or employment of the Government of said United States who uses, or may have used, in the public service, for said Government, any improvement or invention, and letters-patent thereon, in the manner stated in section one of this act; but sole and exclusive jurisdiction over and upon any and every such act of infringement is hereby conferred upon, and vested in, the said Court of Claims, with the same privileges, rights, and powers as now given by law to said district or circuit courts over and upon any letters-patent upon inventions, and all questions of validity or invalidity, infringements, title, or any other matter or question appertaining to any such letters-patent. And this act shall be construed so as to give authority or license to said United States to make for, and to use in, such public service any patented invention, upon the condition, and only the condition, that the patentee, or assignee, or claimant of ownership of such letters-patent, or their legal representatives, shall go to the said Court of Claims in the manner and form provided in this act, for the adjudication, settlement

of, and payment for, such infringement of the letters-patent or use of the invention therein and thereby patented.

SEC. 12. That each and every claim cognizable by the said court under this act shall be forever barred unless the petition or bill of complaint setting forth a statement of the case and claim, as herein required, be filed in said court within three years after the cause of action first accrued: *Provided*, That any such claim which has accrued prior to the passage of this act shall not be barred if the petition or bill of complaint be filed in said court within two years after the passage of this act, and not more than six years after the expiration of the term of years for which the letters-patent were granted, or re-issued, or extended and renewed.

SEC. 13. That either party aforesaid may appeal to the Supreme Court of said United States within ninety days next after judgment or final decree shall have been made and ordered by said Court of Claims as hereinbefore provided, such cases so appealed to be preferred causes in said court; and if the said judgment or final decree shall not be appealed, or, if appealed, and the said judgment or final decree shall be affirmed by said Supreme Court, then the same shall be certified by the said Court of Claims to the Secretary of the Treasury of the United States in the same manner as now provided by the law in relation to any other judgment of said Court of Claims; and the same, when presented to the Secretary of the Treasury aforesaid, shall have the same effect as now provided by law, and shall thereupon be paid out of the appropriations which shall annually be made for the payment of the judgments of said court rendered under the provisions of this act; and the payment of such judgment shall be in full satisfaction for all claims for compensation for the use of such patented invention or improvements up to the time of the making and entering of such judgment or decree thereon by said court, and no longer.

[Senate Report No. 467, Forty-fourth Congress, first session.]

IN THE SENATE OF THE UNITED STATES, *July* 15, 1876.—Ordered to be printed.

Mr. WADLEIGH submitted the following report, (to accompany bill S. 571:)

The Committee on Patents, to whom was referred the bill (S. 571) extending the jurisdiction of the Court of Claims of the United States, and for other purposes, report:

Your committee have duly considered the same, and, after a careful and thorough examination of the whole subject-matter contained therein, have come to the conclusion and determination that the same has merit, and strongly invites and demands the most favorable consideration and action of the Congress of the United States. Your committee, therefore, recommend the passage of the accompanying bill as a substitute for Senate bill No. 571, first above mentioned.

The examination by your committee into the several matters contained in the bill discloses the fact that it is an important public measure, whereby the Government and the citizen are alike protected, upon common grounds in equity, as well as before the organic law of the land, by which the several Departments of the Government will now and hereafter be greatly relieved from that class of burdensome, vexatious, and

expensive litigation so fully and clearly specified in the annual report of the Chief of Ordnance to the Secretary of War for the fiscal year ending June 30, 1875, on pages 11, 12, and 13 thereof, under the title of "Infringement of patents," which was fully confirmed and approved by the Secretary of War in his report to Congress on the operations of the War Department for the fiscal year ending June 30, 1875, and found on pages 19 and 20 of volume 1 of that report, to each of which your committee most respectfully request the attention and consideration of the Senate, and which your committee make a part of their report.

In order that your committee might be in possession of the facts upon which this bill appeared to be founded, so as to give to the Senate as full and correct information as possible to be had concerning the matters contained therein; and inasmuch as the Secretary of War had, in his annual report to the President, dated November 22, 1875, made mention of the same subject-matter contained in the bill, among other things saying: "It is, therefore, a question in the interest of the patentees themselves, as well as of public economy, whether some particular forum should not be named wherein claims of the character here referred to should be *exclusively* brought. I would respectfully submit it to the wisdom of Congress whether jurisdiction ought not to be given to the Court of Claims in all cases of the character here explained when the United States is defendant. I earnestly recommend that some action may be taken at the coming session on this subject;" and the same having been approved by the President, and by him transmitted to Congress in his last annual message, Senate bill No. 571 was transmitted to the Secretary of War, and by him was referred to the Chief of Ordnance on the 13th day of March, 1876, for him to examine and report thereon.

On the 16th day of March, 1876, the Chief of Ordnance, General Benét, made a report in writing to the Secretary of War, which is in the following words, to wit:

SIR: I have the honor to return Senate bill No. 571, "extending the jurisdiction of the Court of Claims of the United States, and for other purposes," now pending before the Senate Committee on Patents.

I also transmit an extract from my annual report of 1875, on "infringement of patents," and copy of a letter addressed to the honorable Secretary of War, October 11, 1875, on the same subject.

The provisions of this bill meet my hearty approval, believing that they will relieve the War Department from great embarrassments which have been frequently brought to the attention of Congress in previous reports, and give a sure, speedy, and uniform method of settling the claims of patentees against the United States for the use of patents.

If the views expressed in the inclosures meet with the concurrence of the honorable Secretary of War, it is respectfully recommended that favorable action on the inclosed bill be asked of Congress.

On the 22d day of March, 1876, the Secretary of War transmitted the said report of the Chief of Ordnance, together with other papers on the same matter, to the chairman of the Senate Committee on Patents, which was in the following words and figures, to wit:

SIR: I have the honor to invite your attention to the inclosed letter from the Chief of Ordnance, dated the 11th instant, and accompanying papers, in regard to Senate bill No. 571, "extending the jurisdiction of the Court of Claims of the United States, and for other purposes."

The letter of the Chief of Ordnance of October 11, 1875, (copy inclosed,) was transmitted to the Attorney-General on the 16th October, by the Secretary of War, requesting his views, (copy of letter inclosed,) and a copy of the reply of the Attorney-General, dated the 19th of October, is herewith inclosed.

Action with reference to this matter was earnestly recommended by the Secretary of War in his annual report for 1875. (See pages 19 and 20 of inclosed pamphlet-copy.)

Concurring in views of the Chief of Ordnance, I have respectfully to recommend favorable action on the bill in question.

Your committee most respectfully request the attention of the Senate to the letter of the Chief of Ordnance to the Secretary of War, dated the 11th day of October, 1875; also, the letter of the Secretary of War to the Attorney-General, dated October 16, 1875, on the same subject; also, the reply of the Attorney-General thereto, dated the 19th day of October, 1875. The said letter from the Secretary of War is as follows, to wit:

SIR: I have the honor to transmit for your views the inclosed letter from the Chief of Ordnance, dated the 11th instant, suggesting the propriety of an effort to secure from Congress necessary legislation under which proper compensation may be awarded to holders of patents used by the United States in the manufacture of war material.

I beg to inquire your views as to the expediency of uniting with this Department in recommending the subject to the favorable consideration of Congress at the ensuing session.

The Hon. ATTORNEY-GENERAL.

To which the Attorney-General, under date of October 19, 1875, made the following answer, to wit:

SIR: I have the honor to acknowledge the receipt of your letter of the 16th instant, inclosing a communication addressed to you on the 11th instant, by Gen. S. V. Benét, Chief of Ordnance, together with an extract from his annual report for this year.

The subject suggested by these communications is, that of the propriety of an effort to secure from Congress necessary legislation by which compensation may be awarded to holders of patents used by the United States in the manufacture of war material. I concur fully with the views of General Benét concerning the necessity of such legislation, and will consider further of the subject, and communicate any suggestions which seem to me to be right and proper concerning the legislation to be asked for.

Hon. SECRETARY OF WAR.

Your committee, after the said Senate bill had been referred to the Secretary of War for information, as before stated, and after the report and opinion of said Secretary of War had been received by your committee, thought it best to ascertain the views of the several Executive Departments named in the first section of the bill. The matter was accordingly submitted to those Departments, and, after examination by each, the general plan was adopted and approved by each of them in very strong terms. Several important amendments were by one or more of them proposed, each of which your committee have incorporated in the accompanying substitute bill, which your committee fully approve and recommend to the favorable consideration of the Senate.

The accompanying substitute bill is the result of a long, patient, and careful examination and consideration of the whole subject-matter submitted to your committee by the Senate, touching the "extending of the jurisdiction of the Court of Claims of the United States, and for other purposes," so as to embrace the subject-matter of letters-patent upon inventions used by officers of the United States in the public service, and to provide suitable means for the settlement of such use of private property.

The said substitute bill is fully approved by the several Executive Departments of the Government, as containing ample provisions for the protection of the Government in all claims of the kind stated in the bill, as well as patentees or claimants claiming for the use of any patented improvement and invention.

From the foregoing communications it fully appears to your committee that, in the management of public affairs by the several Departments of the Government, there exists, in fact as well as in law, and in justice to both the Government and the citizen, a pressing necessity for the passage of a bill by which the rights of the citizen-inventor as well as those of the Government of the United States, with reference to the use by that Government of that kind of property protected and secured

by letters-patent, shall be fairly and properly adjudicated and determined as between them in the least expensive and most expeditious manner possible.

Such your committee believe the accompanying bill to be. We are fully persuaded that it covers the entire ground of the subject-matter contained in the several communications to which your committee have hereinbefore referred, and that it is so guarded as to protect the rights of all parties in interest fairly and equitably.

The Government of the United States has no legal or equitable right to take the property of an inventor, secured to him by the law and by the grant of letters-patent thereon, and apply the same to its own use, gain, or profit, without a just and fair compensation therefor, any more than it would have to seize the personal and real property of the citizen, and drive him and his family from their home, and, without shelter and compensation, deprive him and them of their daily earnings, or of their lands, horses, cattle, and house. Would the Government have the right to use the railroads of this country for the transportation of its mails, or for other purposes, without paying the owners for that use? Would it have the right to take the telegraph-lines of the country and convert the same to its own use without making a just compensation therefor, even in time of war? If not in war, how much less so in time of peace. As well might this Government undertake to compel persons to leave their business affairs, and to go and render service in its executive, legislative, or judicial departments without compensation therefor, as to take the patented property of the mechanic and inventor, and put the same into the public service without compensation therefor.

The Constitution of these United States stands as firmly as does stand the rock of Gibraltar between the Government and the citizen, and it there solemnly declares the fundamental law of the land to be, in these plain but positive words, to wit: "NOR SHALL PRIVATE PROPERTY BE TAKEN FOR PUBLIC USE WITHOUT JUST COMPENSATION." (See Article V of the amendments of the Constitution.)

The learned Judge Story says:

Private property is the sacred right of individual dominion. It is one of the great absolute rights of every citizen of the Republic to have his property protected; and the Government has no right whatever to deprive him of it, except for the use of *the* public; and not even then without a *fair*, *just*, and *equitable* compensation. It is a well-settled principle that no man shall be disseized of his freehold or of his *private* property without full compensation therefor when taken for the use, gain, and profit of the public, by the order, or by the directions, or by a specific or implied contract on the part of the Government. This is an affirmance of a great doctrine established by the *common law* for the protection of *private* property. It is founded on natural equity, and is laid down by jurists as a principle of universal law.

The Supreme Court of the United States, in the case of Seymour *vs.* Osborne, (11 Wallace, U. S. S. C. Reports, page 533,) have solemnly decided and determined the law of this country to be that letters-patent upon mechanical invention are property, and as such may be held and owned the same as real estate or personal property, and that the inventor and his lawful representatives are justly and rightfully entitled under the law to full protection as against any one and everybody using the invention covered by such patent without license.

In that decision, among other statements, that court uses the following language, to wit:

Inventions secured by letters-patent are property in the holder of the patent, and as such are as much entitled to protection as any other property, consisting of a franchise, during the term for which the franchise or the exclusive right is granted.

Letters-patent are not to be regarded as monopolies, created by the executive au-

thority at the expense and to the prejudice of all the community except the persons therein named as patentees, but as public franchises granted to the inventors of new and useful improvements, for the purpose of securing to them, as such inventors, for the limited term therein mentioned, the exclusive right and liberty to make and use, and vend to others to be used, their own inventions, as tending to promote the progress of science and the useful arts, and as matter of compensation to the inventors for their labor, toil, and expense in making the inventions, and reducing the same to practice for the public benefit, as contemplated by the Constitution and sanctioned by the laws of Congress.

Upon the same subject-matter of property, and the exclusive right to make, use, and vend the same to others to be used, that learned and profound scholar and jurist, Mr. Chief-Justice Marshall, in the case of Evans *vs.* Jordan, 1 Brockenbrough's U. S. C. C. Reports, page 252, said:

The Constitution and the law together give to the inventor, from the moment of discovery, an inchoate property therein, which is completed by suing out a patent. This inchoate right is exclusive. It can be invaded or impaired by no person, and no right can be acquired in it without the consent of the inventor.

That able and much-respected judge, Mr. Associate Justice McLean, in the case of Allen *vs.* Hunter, 6 McLean's U. S. C. C. Reports, page 306, declared and decided that—

The law gives to the inventor the exclusive right and use of the thing invented or discovered, as a compensation for his ingenuity, labor, and expense in producing it.

Judge Nathan K. Hall, formerly Postmaster-General of the United States, in the case of Ransom *vs.* The Mayor and Commonalty of the city of New York, 1st of Fisher's Patent Cases, page 259, among other declarations and conclusions, said:

A patent when granted becomes, to a certain extent, a contract on the part of the Government with the patentee that they will protect him in the exercise of the exclusive privileges which his patent gives him.

The Supreme Court of the United States, at the December term, 1870, in the case of Burns *vs.* The United States, which, upon appeal, became The United States *vs.* Burns, 12 Wallace U. S. S. C. Reports, page 252, unanimously decided that the Government could not rightfully or lawfully use a patented invention without license of the inventor, or making compensation to him therefor. In that case that court said:

If an officer in the military service, not specially employed to make experiments with a view to suggest improvements, devises a new and valuable improvement in arms, tents, or any other kind of war material, he is entitled to the benefit of it and to letters-patent for the improvement from the United States, equally with any other citizen not engaged in such service; and the Government cannot, after the patent is issued, make use of the improvement any more than a private individual, without license of the inventor or making compensation to him.

Such have been, upon this question of franchise, of property, and of exclusive right and title in patents, the opinions and decisions of the highest courts in this country, commencing with Mr. Chief-Justice Marshall and coming down to the present time through the circuit and Supreme Courts of the United States.

As the law now is, if the Government desires to use property covered and protected by patents, as is now very frequently the case, it must either wrongfully and willfully violate the law by infringing the patent in the manufacture of the article desired to be used in the public service, or else contract with private individuals or companies having no license, and with whom the Government would be forced to submit to greatly advanced prices, and yet, after all that, would still be liable to the inventor or his lawful assignees for the use of the invention and letters-patent thereon, in the public service. And this the Government have

no right whatever, founded in justice and a due regard for the law, to do. It cannot afford to make laws for the people to be governed by, and then violate and disregard them. The subject of the patent is regarded by the law as the *property* of the inventor alone, as "under our patent-laws it is only the *inventor*, the person in whose brain the new form or method has been conceived, who can be invested with the patent-right;" and the United States, using the same for public purposes whereby to benefit the people in their public service, ought, in equity, in common justice, and in good conscience, to pay for the same, as it would and does pay a railway company for transportation of the mails, or a telegraph company for the use of its wires in transmitting Department messages, or the farmer for his horse and wagon for the public service, or the mechanic for his day's labor, or the President of the United States, his Cabinet, or other officers, for services rendered the public in *official* place.

To have a good government and full obedience to the law, the Government itself should obey the law, and in all things deal honestly and in exact justice with the humblest citizen of the Republic. It cannot demand or require the service, labor, or the real or the personal property of the citizen for any purpose or use whatsoever, without a *just* and *reasonable* compensation.

Officers and other persons in the employment of this Government, who, in obedience to superior orders, make or use an invention protected by letters-patent of the United States while in that employ, not for their own use, but for the use of the Government, and that, too, in the public service, are now held liable in the circuit courts of the United States for infringement of such patent. They may be, and several have already been, enjoined and restrained by the *injunction order* of the court from either making or using the patented invention for the Government; and they may also be, and some are already, *personally held* to answer to a judgment for damages and costs and execution therefor, and their property put in jeopardy and their homes threatened and invaded by the officers of the law with the process or writ of execution for such infringement by them, in the service of the Government, through no fault of their own. Your committee are informed that there are not only several suits of this character now pending against certain officers of the Government, to the great injury of the public service, but that others are contemplated, while some are actually in process of preparation. These suits are not confined to the War Department, but they extend, and are extending, to the Treasury, Interior, Navy, and Post-Office Departments, with no lawful authority on the part of the Government to stay them. They are expensive and burdensome to those officers, and they harass and embarrass the Departments in the successful management of public affairs.

It is not only apprehended, but actually suggested, by the War Department, that in all probability such officers as have been thus embarrassed and threatened with financial ruin will in due time call upon Congress to re-imburse them for such losses in damages and costs sustained by them in the public service as faithful officers obeying the orders of their superior. The able and exhaustive report of the Chief of Ordnance, General Benét, to the Secretary of War, on the subject of the "*infringement of patents*" by the Government, and hereinbefore referred to, will give full information on this point. It is well known that such suits cannot be prevented, and that they greatly hinder and disarrange the public service in the several Departments of the Government. There is, and there ought to be, no honorable or honest "ways and

means" that this Government can devise whereby to withhold payment for the use in the public service of *property* secured for a term of years by the grant of letters-patent, and appropriated to that service by that Government. It ought to pay a *fair* and *just* compensation for that use. This would be but an act of justice and of *honest* dealing with the citizen inventor, and it would stimulate him to greater activity in the fields of invention. But for the inventive genius of the land, what would be the condition of our country to-day? What would be that of our agricultural fields? What and where would be our railroads, our steamships, our land and ocean telegraphs, our commerce, our factories, our storehouses, our shops, our mining for the deep-hidden treasures of the earth, our arts and literature, and our homes? Who, then, shall wish, for one moment even, to stay the rising tide of genius and invention, and roll back the progress of the age in which we live? Who, therefore, shall labor, or even wish, to withhold from the inventors in this country that *just* compensation which belongs to them, both by the organic and statute law, for their ingenuity, their time, their toils, and expenditure of money in creating PROPERTY in invention in the manner provided by the statute law and sanctioned by the nation's Constitution?

In conformity to the principles laid down in this report, your committee are of opinion that the Government ought to pay a *fair* and *just* compensation for the use of property vested in patents on mechanical inventions and put into the public service, and that Congress should now provide the way and manner in which and by which it can *rightfully* be done.

It is a self-evident fact that something ought to be done immediately whereby to relieve the War Department of the embarrassments and difficulties which the Chief of Ordnance sets forth so earnestly in his said annual report, and the other and several Departments of the Government also have substantial relief in the same direction.

After a most careful and thorough examination of the whole case and of the official papers referred to and submitted to your committee concerning the subject-matter of the pending bill, we have come to the conclusion, and have determined, that the better way to settle and dispose of the entire subject is to recommend the passage of the accompanying bill as a substitute for Senate bill No. 571.

It will be seen by the letter of the Chief of Ordnance, General Benét, dated the 16th day of March, 1876, that Senate bill No. 571 was, by the Secretary of War, referred to the Chief of Ordnance for examination and opinion in writing thereon; and that it was examined by him, and returned with a written report indorsing the bill and recommending its passage as a sure, safe, economical, and speedy course to pursue for the settlement, award, and determination of all matters mentioned and referred to in this report as between the Government, on the one hand, and inventors on the other. Your committee are of the opinion that the accompanying bill places the Government and the inventor or his lawful representatives upon the same ground and equal footing for a proper settlement and adjudication of the rights and interests of each as to *property* in patents and the use of the same by the Government.

A general law of the kind proposed by this bill would, it is believed, protect alike all the Departments of the Government, and will relieve at once the officers thereof who have used and are now using this kind of property.

It would bring all matters relating to the use of patents before one and the same court, the Court of Claims, with the right to appeal therefrom by either party. Both courts being at the capital of the nation,

the Government could the better attend the same for the purposes named in the accompanying bill.

In addition to the many reasons already given, the examination of all matters that are similar in character, embodying similar principles and facts, probably applying to one and the same mechanical construction, is placed in the hands of the same judges, who are thus better qualified to hold evenly the "scales of justice" as between nice and conflicting interests on questions of invention, of infringement, and of right, title, and ownership, as between all parties to any suit brought into court, tried and heard in the manner provided in the substitute bill.

By the passage of this bill Congress would, it is believed, be entirely relieved from the consideration of petitions or bills, or both, heretofore introduced for different persons at almost every session asking for substantially the same relief that is fully provided for in and by this bill.

The substitute bill appears to be carefully and properly guarded, so as to protect all parties in interest, no matter what those interests may be, in a fair and proper administration of justice.

Your committee, therefore, recommend the passage of the accompanying bill as a substitute for Senate bill No. 571, at an early day and during the present session of Congrss.

APPENDIX K.

REPORT OF COL. T. T. S. LAIDLEY, ORDNANCE CORPS, U. S. A., ON EUROPEAN GUNPOWDER, GUN-COTTON, AND GUN-CARRIAGES.

WATERTOWN ARSENAL, *November* 10, 1876.

To the CHIEF OF ORDNANCE:

SIR: I have the honor to report, in compliance with the order of the Secretary of War, which directed, under the date of May 22, 1873, that "Lieut. Col. T. T. S. Laidley, Major Benton, and Major Crispin, of the Ordnance Department, United States Army, will proceed to England, France, Germany, Austria, and Russia, for the purpose of collecting information in regard to the construction of heavy cannon and other ordnance manufactures. * * * The information gathered will, on their return, be submitted to the Chief of Ordnance."

The better to comply with the last clause of these instructions it was mutually agreed that we should unite and make a joint report, each officer furnishing his portion, embracing all that referred to the subject on which he was to write. Gunpowder, gun-cotton, and gun-carriages of the different kinds were the subjects which were to be written up by me.

As there now seems to be little prospect of our original agreement being carried out, I have concluded not to wait any longer in expectation thereof, but to transmit, as I do herewith, my report on gunpowder, gun-cotton, and gun-carriages, in the hope that, though imperfect, as it must necessarily be from the hasty manner in which the materials for it were collected, it may not be without interest to officers of the Department, and perhaps to some others.

Very respectfully, I am, your obedient servant,

T. T. S. LAIDLEY,
Colonel of Ordnance.

GUNPOWDER.

The recognition of the fact that different guns require for their most efficient service different powders marks an important epoch in the history of gunpowder. Previous to this time powder was the same, whether it was to be fired in a 6-pounder or 10-inch gun, and though experience showed that the large gun did not resist the strain of the discharge as well as small ones, the difference in their endurance was attributed to other causes than the want of adaptation of the powder to the gun. It was not suspected that the trouble arose from the unsuitableness of the powder.

It soon became a recognized fact that the combustion of gunpowder was influenced to a great degree by the size, the shape, and the density of the grain; and as the weight of the projectile to be started became greater, so much greater became the necessity of regulating these particulars in the powder to be used. The improvements which have been made by attention to these particulars have rendered it practicable to use larger guns and heavier projectiles than had been deemed only a few years before to be within the limits of possibility. The point to be attended to is to see that the evolution of gas at the first moment of

inflammation is not excessive, and this is effected by reducing the surface of ignition, that is, by increasing the size of the grains. Further, the evolution of gas should be gradual and progressive, and this is accomplished by giving the grain such a density that the hot gas shall not be forced by the pressure through the mass of the grain. The shape of the grain is also a matter of much importance, as influencing the progressive evolution of the gas. That shape of grain must be best which, other things being equal, has at first a small burning-surface and one that is continually increasing; or, this being deemed impracticable, the grain which approximates nearest this ideal must be best. The prismatic-shaped grain, with perforations running through it parallel to the axis of the prism, is to be preferred to all others that have yet been proposed. If it has not thus far given better results than others, it is because the practical difficulties in the manufacture are such as have not yet been overcome satisfactorily; but it by no means follows that they are such as may not, by future improvements, be surmounted.

It is an established fact that the quality of powder made from day to day will vary with the hygrometric state of the atmosphere, and it is almost impossible to make, at different times, two lots of powder which shall be the same in quality. The ingredients, if incorporated with a certain amount of moisture, will produce a different powder from the same materials mixed with a different quantity. Notwithstanding this fact, no efforts have been made to eliminate this source of variation, as it is believed might be done by keeping the air of the incorporating-mill constantly charged at all times with moisture.

An important step has been made, however, to avoid this cause of difference more completely in a different way, and that is by the entire exclusion of water in all of the processes of fabrication. The improvement comes from Russia, as did the machine for making the prismatic powder. The materials, after being pulverized and thoroughly incorporated in tumbling-barrels, are raised in temperature up to the melting-point of sulphur at the same time that they are compressed into a cake. They are then cooled while under this pressure. The press-cake is broken into grains and glazed in the usual way. The charcoal has absorbed no moisture, and, as was to be expected, the powder has been proved to be stronger, and, it is said, more uniform in quality, than ordinary powder. Should this process develop unknown difficulties and come short of the expectations that have been raised by it, nevertheless it will most likely exercise a beneficial influence on the mode of manufacture by stimulating and directing investigations in a direction that will probably lead to important results in the end.

Gunpowder fails, in too many respects, to come up to the ideal of what the projectile-compound of the present time should be to retain its place much longer, unless marked changes shall be soon made in some of its properties.

ENGLAND.

English gunpowder has been long held in deservedly high estimation for its strength or explosive force, a quality which has been obtained for it by the exercise of great care in the selection of the best materials, and by the close attention paid to every detail of their preparation and thorough and complete incorporation.

The greatest improvements have been made in the quality of the powder since the time when, instead of procuring the supplies required for the military and naval services by contracts with private parties, the

government became the owner of a powder-mill, and the manufacturer of its own powder, or a part of it, the different processes of fabrication being carried on under the immediate direction and supervision of its own agents. This mill is not of sufficient capacity to supply all, or anything like it, of the powder that is required in times of war; but, besides being of the greatest use in keeping up the high standard of the quality of powder, (samples of standard powder are furnished annually to all powder-makers of the kingdom,) it is also of value in keeping down the price when supplies have to be procured from private manufacturers.

The royal gunpowder factory at Waltham Abbey is situated very near the old church from which it takes its name, about 12 miles from London, on the Eastern Counties Railway. The grounds are the rich meadows on the river Lea, which stream connects the canals between the different mills with the Thames, and furnishes water-transportation to Purfleet, where the powder is stored in large magazines. A portion of the grounds is planted with willows, set out with great order and neatness, the wood to be used for making charcoal for powder. The buildings in which the different processes of fabrication are carried on are scattered over upward of fifty acres, and built with special reference to the purposes for which they are intended. The niter and sulphur used are procured in the crude state and refined at the factory. This course is pursued in preference to purchasing them already refined, with a view of insuring uniform results in the powder manufactured, and of guarding more effectually against accidents, so much to be dreaded, from the presence of foreign particles in the materials, introduced among them before they reach the mills.

The grough saltpeter of India is purchased to the exclusion of all others. The process of refining is the usual one, and has in it nothing calling for remark. The water used is from an artesian well, and is remarkably pure and free from all mineral substances.

The sulphur is procured from Sicily, and contains from 3 to 4 per cent. of earthy matter, from which it is purified by distillation. It is ground under a small pair of wheels, when it is ready for mixing.

Willow and alder are the woods used for making charcoal for all powders except musket. For this latter, the alder buckthorn, or berry-bearing alder, (*Rhamnus frangula*,) commonly known as the black dogwood among powder-makers, is exclusively used. All of these woods grow in different parts of England, and efforts have been made to cultivate them on the grounds of the powder-mill, with success as regards the first two, but not the last, which requires a poor and rocky soil instead of rich meadow-land for its growth. Large quantities of the dogwood are stored away for future use at the factory; the sticks, of about one inch in diameter, all brought from Prussia, at a cost of from $60 to $75 per ton. The difference between this and all of the other woods commonly regarded as best adapted for making powder is most marked, all of the others being light, brittle woods of rapid growth, whereas this is a dense, tough wood of slow growth, requiring usually ten years to attain a size of one inch in diameter.

The charcoal is prepared by distillation in cast-iron retorts of cylindrical shape, set in brick-work, with flues to conduct the flame all round them. The gaseous matter and tar evolved in the distillation is conducted by pipes into the fire, and, besides economizing fuel in preparing the charcoal, furnishes the readiest means, by the color with which they burn, of determining when the charcoal has been carried to the proper point.

For convenience in handling, the wood is first put in sheet-iron cylinders, which are placed in the retorts. The retorts being thoroughly heated, the operation of charring requires from 2½ to 3½ hours.

As the quality of the powder depends greatly on the temperature at which the charcoal is prepared, great care is taken to have this temperature constant and sufficiently high, but not too high. This is indicated by the color and fracture of the coal, which should be a jet black, with a clear velvet-like look when freshly broken.

Analysis confirms the practical experience of powder-makers, that dogwood charcoal makes a stronger powder than coal of any other wood, containing as it does a greater amount of gaseous constituents.

The charcoal is ground in a mill resembling an ordinary coffee-mill, and is sifted by passing it into a cylindrical frame covered with iron-wire cloth, 32 meshes to the inch, and having a rotary motion around its longer and horizontal axis.

The proportions of these ingredients are the same as those used in this country. They are weighed out in the proper proportions for a 50-pound charge, the saltpeter containing from 3 to 6 per cent. of moisture, and are mixed together in the mixing-machine. This consists of a hollow bronze drum, which makes 40 revolutions per minute. A shaft passes through the axis of the drum, having a large number of arms made fast to it. The shaft and arms revolve in the opposite direction to the drum, and at twice its speed, thus mixing the ingredients together.

The thorough incorporation of the materials is effected under heavy cast-iron or stone wheels, as in this country. The wheels are of various sizes, some as large as 7 feet in diameter, and others only one-half of this, the preference being given to the smaller, as they are not so apt to cause explosions. The weight varies from 3½ to 4 tons. The bed is about 7 feet in diameter.

There are in all 32 pairs of wheels for incorporating. A portion of them are driven by water-power, others by steam. The time required for the incorporation of a charge depends upon the kind of powder, the weight of the wheel used, and its velocity. Cannon-powder requires from 2½ to 3½ hours; musket-powder from 4 to 5½ hours.

For the convenience of applying the motive-power, the wheel-mills are placed in groups of four or six; and to prevent the explosion of one from extending to others of the same group, each is provided with a large vessel of water overhead, so arranged that an explosion of either mill of the group will overturn all of these vessels and pour the contents into the mill-bed beneath. This apparatus has been found to answer a good purpose, and has saved at different times a large amount of property.

The buildings in which these mills are placed are erected with a view to occasional explosions of charges, and are constructed accordingly, so that the damage shall be confined to one portion of the building, which can be readily repaired. The walls on three sides are three feet in thickness, while the fourth side is made of corrugated iron and glass, which will yield readily to the explosion and relieve the strain on the other parts of the building.

Before being taken to the press-room to be pressed into cake, the mill-cake is passed through the breaking-down machine, which breaks up the lumps into a fine state of division to facilitate the operation of pressing.

The breaking-down machine consists of a pair of gun-metal, cylindrical rollers, grooved longitudinally. They are placed side by side, their axes parallel and horizontal. The bearings of one roller are not fixed,

but can be moved to or from the other, and are held in their proper position by means of a weight. The two rollers revolve in opposite directions, and the powder passing between them, the cakes and lumps are broken up into a meal. A second set of rollers like those just described are placed directly under them, and break up any lumps that may have escaped the action of the first pair.

The powder to be broken up is placed in a large hopper, from which it is carried to the rollers by an endless belt of strong canvas, which passes through an opening at the bottom of the hopper to the top of the machine, where it falls between the first pair of rollers.

The press used for pressing powder into thin cakes is operated by water pumped into a vertical cylinder. The press-box, in which the powder is placed, is 30 inches by 14 inches inside, made of great strength, of bronze, lined on the inside and outside with oak boards. Three sides of the box are hinged to the bottom, and when closed are secured by short, strong bronze screws. In order to charge the box the open top is temporarily covered with a piece of board, and the boxes turned over on one side. Bronze racks, with vertical grooves in them 1¼ inches apart to hold the press-plates, are placed against two opposite sides, and the plates, 48 in number, slipped in. The spaces between the plates are filled with powder thrown in with a shovel, and the racks are then withdrawn, leaving the powder in layers 1¼ inches thick, with a plate between the consecutive layers. The side which is now on top is screwed fast, and the box is turned over onto the table of the hydraulic press, bringing the press-plates horizontal. The board cover is removed, and a solid wooden block overheard, which resists the pressure of the ram, is adjusted so as to enter the box and be forced deeper and deeper into it as the powder is compacted. The pressure is applied by pumps driven by water-power in another building, between which and the press-house there are large earthen traverses.

The degree of pressure to which the powder is subjected is estimated by the reduction made in its volume; when the table of the press on which the powder is placed has risen to a given height, and compressed the powder within to a given compass, previously determined by trial, a trigger is released and a bell rings in the pump-room as a signal to stop the pumps and relieve the pressure.

The press-cake is broken with wooden mallets into pieces about the size of a man's hand, and transferred to the granulating-machine, to be broken up into the required size of grains.

The granulating-machine consists of two bronze side-frames supporting four pairs of bronze toothed rollers, placed on different levels, their axes horizontal and parallel to each other. The first set is placed at the top of the machine, about 20 feet from the floor, and the press-cake is first passed between them and by them broken up. The pieces fall on a rectangular screen, inclined to the horizon, by which they are conducted down to the next set of rollers, and are there broken into still smaller pieces, and so on to the last set.

The screens are made of wire-cloth, with meshes of such size as to allow grains of powder of the required size to just pass through. Under this screen is another still finer, which permits all dust and grains finer than the required grain to pass through; and beneath this is a board to catch and transfer all dust that passes through the second screen into a tub at the bottom, to be worked over again.

The rollers composing each set are adjusted to the proper distance apart by set-screws, one roller working in sliding-bearings, which are kept in place by means of a weight acting on a lever permitting it to

yield without injury to the machine in case an excess of material shall pass between the rollers. The teeth of the first set are pyramidal in shape, one-quarter of an inch high; the second set have teeth similar to the first, but only one-eighth inch in height; and the others have chisel-shaped teeth or are perfectly smooth.

The press-cake is placed in a hopper near the floor, and is carried thence to the first set of rollers by an endless canvas band, with strips of leather sewed on it. The cake falls between the rollers, which revolve toward each other, making 30 revolutions to the minute. It is broken into pieces varying in size, and falls on the short screen leading to the second set of rollers. The screens have a quick vibratory motion communicated to them by means of a polygonal wheel which works against a loose pulley attached to the screen-frames. This motion causes the pieces of cake to travel down the inclined screens to the next set of rollers, where they are again broken till their size is reduced sufficiently to permit them to pass through the screen, and are then deposited in a box at the foot of the long screen.

The hopper is counterpoised by a weight suspended to a cord passing over a pulley, and as the cake is removed by the endless band and carried to the rollers the hopper rises, and when emptied a clutch is released and a bell rings in the watch-house, where the workmen remain while the machine is running—a signal to replenish the hopper.

The powder of the proper-sized grain is taken to the dusting-house, but the dust and small grains are taken back to the mills, to be worked over under the wheels.

As cannon and musket powder differ in other respects besides the size of grains, being made in the first place of different kinds of charcoal and of widely differing densities, it is not possible to convert the small grains of the former into powder of the latter class. It is therefore necessary to take all that passes through the small-gauge sieve and re-work it under the wheels with fresh materials.

Pebble-powder is formed from dense cake five-eighths of an inch in thickness by breaking it into cubes, the length of the faces being equal to the thickness of the cake. The machine used for this purpose is of a special construction. It is composed of two fluted bronze rollers, (see Fig. 1, Plate 1,) each 6 inches in diameter, placed about a half inch apart, their axes horizontal and parallel. The teeth formed on the roller by fluting it are about a half inch apart. The rollers revolve in opposite directions, and the corresponding teeth of the two rollers pass the plane joining the axes at the same time. A man feeds the machine, holding the cake 14 inches wide by 15 inches long in a vertical position, entering it between the rollers, which break it into right prisms 14 inches long, with square bases. These prisms fall upon a board, the surface of which is gently scraped over by a series of wooden strips or scrapers, secured at their ends to two endless belts passing over two pulleys. (See Plate 1.) Each prism falls between two consecutive scrapers, and is carried sideways along the board and deposited on an endless belt running just below the board and in a direction at right angles to it. This belt conveys it endways to a second pair of toothed rollers, of the same size, which cut it into cubes. If the board were to remain stationary the prisms would fall on top of each other before they could be swept away by the scrapers. To prevent this, the board has a retrograde motion, so that the prisms shall fall side by side, each one slightly in rear of the preceding one. When the board has moved in this way a certain distance, the direction of its motion is suddenly changed, and it moves along with the scrapers and at the same rate, when, having gone a cer-

tain distance, the motion is again reversed. This reciprocating motion of the board, or false bottom, is effected by attaching it to an endless chain passing over two small pulleys 14 inches apart. As the link to which the board is attached passes over either of these pulleys, the direction of its motion is changed, and with it that of the board. The rollers are so adjusted that the teeth shall enter the cake about three-hundredths of an inch, which is sufficient to cause it to break readily along the cut thus made. An assistant is stationed at the end of the false bottom to correct the positions of the prisms as they are swept from it to the band, and to assure their being fed to the second set of rollers in a direction at right angles to their axes. As there are always portions of the pressed cake which are not hard and firm and will not break into cubes, but crumble into dust, or form small and irregular-shaped grains, they must be separated by sieves and returned to the wheel-mills to be ground up and pressed again into cake. This loss is about 20 per cent. of the entire cake used. One machine will cut into grains about 100 barrels of pebble-powder in a day, making it the cheapest kind of powder that is made.

The angles and sharp corners of the cubes are rounded off by the process of glazing, and this prevents the formation of dust in transportation, besides diminishing the surface of first ignition, and the first evolution of gas. Preparatory to glazing, the powder is first dusted.

The operation of dusting is performed in revolving cylindrical reels, which are of two kinds, the horizontal and the slope reel, and used for different powders. The horizontal reel consists of a wooden frame-work of hoops, supported on a shaft by spokes, covered over with canvas or wire cloth of different degrees of fineness, according to the size of the grains to be dusted. The reel is 8 feet long and 30 inches in diameter. The shaft is iron, covered with wood; the ends are disks of wood, and the spokes are bronze. The reel is driven by water-power, and makes about 40 revolutions per minute. The slope-reel resembles in construction the horizontal one; is 20 inches in diameter, has no end pieces, but is open at each extremity; and the shaft, instead of being horizontal, is inclined at an angle of 5½°. At the upper end there is a feeding-hopper, with a loose spout attached to it for guiding the powder into the reel. Fine wire cloth is generally used for covering the reel, and it revolves somewhat slower than the horizontal one, making about 38 revolutions per minute. By the time that the powder has traveled through the reel the dust has been entirely removed from it.

The glazing is done in barrels capable of holding 400 pounds each, and making 40 revolutions for pebble and R. L. G. powder, with which about half ounce of black-lead is added to each 100 pounds. Forty minutes is sufficient to give the required finish to it.

Fine-grained powder has a portion of coarse grains mixed with it, and the barrel is made to revolve slower, making about 34 revolutions per minute, and requiring about 5½ hours to complete it. No black-lead is used with this.

The drying is conducted in a house heated by steam generated in a boiler placed in a building some distance from the drying-house. The steam-pipes are laid along the floor, and are arranged so as to provide for alternate expansion and contraction without leaking, and that the room cannot by any possibility be overheated. The doors of the building are double, and fit tightly, and ventilators are provided which can be opened and closed from without so as to regulate the temperature as may be desired. A thermometer is placed in the building near to a window, which is closed with a shutter and thick pane of glass, so that

the temperature of the house can be read without entering it for that purpose.

Wooden racks are arranged to hold trays made of sheet-copper or wood, with canvas bottoms, for containing the powder.

The maximum temperature maintained in the building is 130°. After the powder has been exposed to this for eighteen hours the temperature is permitted to cool down, and after six hours more the powder is removed, the large-grained powder to be put in barrels for issue and the fine-grained powder to be first dusted and then packed in barrels. For pebble-powder the heat is required to be raised to 135°, and the exposure increased to thirty-six hours, it having been found by experience that without this the moisture was not sufficiently driven off and the full strength of the powder was not obtained.

Pellet-powder is the name applied in England to a powder intended for heavy guns, every grain of which is of the same shape and size, that of a right cylinder with a circular base, with a small hemispherical cavity in one end. Each grain is formed by the compression of a given charge of mealed powder in a mold of the required form. The machine devised for the fabrication of this powder is composed of a series of molds of the exact diameter of the pellet to be formed, each capable of containing just sufficient mealed powder for a single pellet. These molds are formed by boring a series of holes about an inch in diameter in a large bronze plate about 1¾-inch thick, or of just sufficient thickness to contain the required charge of mealed powder. These molds are closed on top by a series of steel punches larger than the hole, coming down closely on the top of the plate, which has been planed to a smooth surface, and on the bottom by punches which enter the mold, making a snug fit. These punches are worked by hydraulic power. The molds are filled by hand with mealed powder flush with the upper surface of the mold plate, and then brought directly under the top punches. The lower punches rising in the molds compress the charges to exactly the proposed length, when the top punches are withdrawn and the pellets forced out of the molds by the further upward motion of the lower punches.

Owing to the expense attending the manufacture and the difficulty experienced in securing uniform results in the density of the different pellets even of the same pressing, the fabrication of this kind of powder has been abandoned, and the so-called pebble-powder, which is made with far less difficulty and at incomparably less expense, and has likewise given better practical results, has been substituted in its place.

The inspection of powder is conducted with a strictness that would surprise our powder-makers. An inspection is made of the pressed cake after each pressing, and its density is determined with the mercury densimeter before it is permitted to pass on to the succeeding processes. The density of musket-powder is fixed about 1.725, and that of pebble-powder from 1.77 to 1.81, and R. L. G. 1.67. The finished product of each day's labor is inspected and proved. The size and shape of the grain are accurately determined.

The proof of the different kinds of powder consists in determining the velocity imparted to a projectile fired from a gun under circumstances as nearly similar as possible to those of actual service. Musket-powder must give the service-ball a certain velocity when fired from the regulation musket; cannon-powder is in like manner proved by testing its strength when fired in the 12-pounder rifled gun; and pebble-powder when fired in a 9-inch or large gun.

The velocity of the projectile is measured by means of the Le Boulengé

chronograph. The first target is placed 45 feet from the gun, and the second 120 feet from the first. The pressure on the bore of the gun is determined by the crushing apparatus, a modification of Rodman's pressure-piston.

Great care is taken, by the enforcement of strict precautions and regulations having for their object the prevention of accidents, against the spread of dangerous results in case of explosions.

The floors of all buildings into which gunpowder is brought are covered over with leather fastened down with copper nails; and all parts of iron, either in the machines or in the buildings, boats, or carts, where they might come in contact with powder, are covered with leather or sheet-lead.

Notwithstanding all of these and other similar precautions, accidents have not been entirely prevented. In the course of the last thirty years two serious explosions have taken place, in one of which seven persons were killed, in the other five.

The maximum annual product of these mills is 2,758,000 pounds of cannon-powder, or 1,369,000 pounds of musket-powder.

The cost of manufacturing pebble-powder is 11 cents per pound, and musket-powder and R. L. G. 16 cents. This does not includes the interest on the investment in the grounds, buildings, machinery, &c.

This factory is under the charge of a colonel, assisted by a captain. The employés are all citizens, and number 150, with a master workman, a master refiner, and a foreman of machinery.

RUSSIA.

In Russia all powder used in the military and naval services, as well as most of that for sporting and mining, is made under the direction of the government at its own factories.

Of private mills there are only a few small ones in Finland, where powder for sporting and mining purposes is made.

The government mills are three in number, and are situated in different parts of the empire:

1st. The Ohktenskoi mills, near St. Petersburg.

2d. The Michael-Schosta, in Little Russia, in the saltpeter district.

3d. That in the Kazan.

Of these the second is the most extensive; the first is provided with the newest machinery and most improved appliances, and was the only one visited.

The Ohktenskoi mills are situated on the Ohkta River, (Plate II,) about six miles from St. Petersburg. They occupy about 1¼ square miles of land, 230 acres of which, where the dangerous operations are performed, being inclosed by a high picket-fence on three sides, and the river on the fourth. The river furnishes the greater part of the power required for running the mills, but their number has been from time to time increased until the capacity of the stream has been exceeded, and now horses have to be employed in addition to the water-power. It is proposed at no distant day to substitute steam in the place of horses where the latter are now used.

The buildings are substantially constructed of brick on three sides, the fourth being of wood, so as to yield readily to any explosive force from within. The side selected for this purpose is that which is in the opposite direction from those buildings nearest to it. The buildings most recently erected, besides being built more solidly, are surrounded

on three sides by an embankment of earth 15 feet high, 40 feet broad at the base, and 12 feet at the top.

It has been found by experience that the vibrations resulting from an explosion are broken most effectually, and contiguous buildings are injured less when a body of water is interposed between them and the place of the explosion. For this reason a canal or pond of water is dug between the mills most liable to be exploded and the houses nearest to them.

The grounds vary considerably in level, and the communication between the different mills is principally by means of wheelbarrows, very little by boat, and none by railway-trucks. The motive-power furnished by the river is well applied. Just below the dam two large iron tubes 200 yards long and 4 feet in diameter, resting upon iron rollers raised on brick piers 6 feet above the surface of the ground, conduct each a stream of water to a series of eight water-wheels placed between a double row of wheel-mills, so that each water-wheel communicates motion to two mills. Some of these water-wheels are overshot, of 12 horse-power, and made of wood; but those most recently put in are of iron and of a peculiar construction. The water enters through a vertical pipe into the interior of the wheel to within about 2 feet of the bottom, and is then discharged from the curved surfaces which form the exterior. It is said to have a co-efficient of .8.

The rollers under the iron pipe are for the purpose of enabling it to accommodate itself readily to the changes in its length caused by the expansion and contraction due to the variations of temperature to which it is exposed; and this is considerable, between three and four inches.

Power for the line of mills B B is furnished by three turbine wheels placed at C. The head of water is 12 feet, and the three wheels, furnishing an aggregate of 1,000 horse-power, can be run separately, or all may be made to act in conjunction on the same shaft. This power is transmitted to the different buildings by means of wire rope running over large pulleys of bronze, the most distant building to which the power is communicated being about one mile from the source.

The proportions of the materials used in the manufacture of gunpowder in Russia are the same as those used in this country and England.

The saltpeter is obtained partly from Little Russia, where it occurs as a natural efflorescence on the ground, and may be much hastened by scraping the surface; and partly from the banks of the Volga, where there are found vast mounds, manure-heaps, which are now so many mines of saltpeter. So far from Russia being dependent upon any other country for this all-important material in times of war, she has within her own territory a larger supply than is necessary for her own wants, and is able to export some to Austria.

Supplies required for the manufacture of gunpowder are furnished at the mills by contractors, already refined and ready for immediate use. The sulphur is obtained from Sicily in the state of roll-sulphur, which is further purified by distillation in the usual way. The charcoal was formerly made from the alder, but it is now made from a variety of the birch. Young trees as large as 5 or 6 inches in diameter are used. It is prepared in the usual way by distillation in iron cylinders in charges of 144 pounds. Fuel being abundant, no effort has been made to economize it by consuming the gaseous products of the distillation of the wood, as is done in England and Prussia.

The charcoal and sulphur are pulverized together in a metal barrel 3½ feet long and the same in diameter. Three parts of charcoal and two parts of sulphur are put into the barrel with bronze balls ¾ inch in di-

ameter. The barrels are set in motion by horse-power, and made to revolve until the materials are reduced to a fine powder and thoroughly mixed together. The balls are separated from the mixture by means of a coarse sieve through which it is made to pass. One part of this composition is added to three parts of saltpeter, and the whole is thoroughly mixed together by hand on a table with raised sides and covered with a cotton cloth having holes in it to admit the arms of the workman. A little water is first added. This composition is next put, in charges of 120 pounds, under the wheels to be ground for four hours. The wheel-mills are of different construction, depending on the date at which they were put in. Those first used are of bronze, with bronze beds, about 4½ feet in diameter, and weigh about 3½ tons each. Those more recently put in are of iron, with iron beds about 7 feet in diameter, and weighing 4½ tons each. Some pairs of wheels revolve around an axis equidistant from the two wheels; in other mills the two wheels travel over tracks of unequal length.

The results of a long experience show that there is no advantage to be had in making the wheels or bed of bronze; that such mills are no more exempt from explosions than the cast-iron mills, and in consequence the use of the costly material in future constructions is relinquished.

The particular arrangement and disposition of the buildings for the incorporating mills adopted at this establishment, by which they are placed in double parallel rows, with a water-wheel between each pair, the buildings being brought so close together, is most convenient and economical in supplying power to the different mills, but is highly objectionable in tending to render the explosions more destructive by increasing the chances of the explosion of one mill communicating to others.

In 1864 a most disastrous explosion took place by which some twenty buildings were destroyed and several lives lost.

The automatic apparatus for drowning the contents of the neighboring mills in case of an explosion in any one, used to advantage at Waltham Abbey, has not been introduced here, though it would seem to be admirably well adapted for the crowded manner in which these buildings are grouped together, and buildings in which explosions occur most frequently of all others.

The powder, as it leaves the incorporating mills, or mill-cake, as it is termed, is broken into pieces by hand with wooden mallets and is passed to the press-house to be formed into cake. This is done by two different kinds of presses, the hydraulic and the Prussian press.

The density of the Russian powder, like that of the Prussian, is very low, cannon-powder being .940, and musket from .920 to .935.

The granulation of the powder is also performed in machines of quite different construction. One is the same as that used in Germany; the other consists of a long bed in which are arranged several series of sieves, each series consisting of four sieves, which are placed one over the other, the coarsest at the top. To this bed containing the sieves a quick horizontal reciprocating motion is communicated by machinery. The press-cake is placed in the upper sieve, and with it hardened lead balls about one inch in diameter. The balls impinging against the cake, breaks it into pieces, the operation being continued until the pieces have been reduced in size so that they will pass through the meshes into the sieve beneath. The smaller pieces pass through the sieves until they have been assorted according to sizes of the meshes, the dust falling into a

trough under the sieves. The contents of the sieves are put away arranged according to the size of the grain, and the dust found in the trough is taken back to be worked over.

The glazing is done in the usual way by the friction of the grains against each other in revolving barrels. It is next dusted, and the grains again assorted.

The drying-houses are placed on either side of the boiler and engine-house, about 150 feet from it.

Steam is conducted by means of pipes from the boiler to the nearest end of the drying-house, where there is constructed an air-chamber heated by numerous small pipes, through which the steam is constantly circulating.

A current of air is forced, by means of a fan-blower, through this air-chamber, where its temperature is raised to about 125° into the drying-house where the powder is to be dried.

The powder is contained in shallow wooden trays with cotton-cloth bottoms, and the air from the air-chamber is first forced through them. The room is filled with wooden racks holding tiers of shallow trays with powder spread out on them. After the powder has been exposed to the greatest heat for four hours, it is transferred to other parts of the room where the heat is less, varying, according to position, down to 88°.

The operation of dusting is different from that generally seen in other mills, though it is believed that its novelty is its only claim entitling it to notice. The machine consists of a horizontal wooden frame, with vertical guides to direct its motion up and down. On the under side of this frame there are pins driven in, from each of which is suspended by its closed end a long narrow bag of coarse linen cloth, something like a shirt-sleeve. The lower and open end of the bag is drawn aside from its vertical position, distended, and made fast to a wooden partition close by. Holes of the size of the mouth of the bag are cut into this partition where the bags are fastened to it, and are closed by snugly-fitting trap-doors which are secured from the outside. The powder is introduced into the bags through these holes until they are less than half full, and the holes closed; a vertical reciprocating motion is communicated by machinery to the horizontal frame, from which the bags are suspended, extending the bag each time its full length, bringing the closed end first above and then below the fixed end, and causing the powder to traverse back and forth from one end to the other and by its gentle motion to sift the dust through the cloth, when it falls to the floor beneath.

Prismatic powder is made by compressing a given charge of soft grain-powder, which contains from 5 to 6 per cent. of moisture, in a strong mold of the required size. The holes in the prism are formed at the same time the prism is made by means of small tapered spindles, which pass through the powder and the compressing-punches. The only machine that has been devised for the manufacture of this powder is that designed by Professor Vichnegradski, and made in Russia, and since copied in Prussia and Holland.

The idea of using powder compressed into a solid cake with parallel holes running through it forming surfaces of combustion which shall be continually increasing as the combustion continues, was borrowed, as the Russians themselves frankly admit, from some experiments made first by Captain Rodman at Fort Monroe in 1861, and witnessed by a distinguished artillery officer of the Russian army. The idea was carried out successfully in a practical form first by the invention and operation of this machine, which is essentially a strong vertical punch, carrying

six punches, and forming six prisms or grains of powder at each revolution of the shaft or descent of the punches. It is widely different in its general design and working from the machine made in England for pressing the grains of pellet-powder, as well as more successful and economical.

(PLATE III.) The Russian machine consists essentially of a stiff cast-iron frame A, about 5½ feet high, which forms a support for a strong shaft, B, and mold-bed C, and serves also, by means of two slots D D, as guides to direct the vertical motion of the two cross-heads E F, each holding six hexagonal punches. These cross-heads have a reciprocating motion communicated by the shaft B through the wheels H K, and eccentrics L and levers N. A hopper, O, holds a supply of grain-powder, and the charger-plate is bored with six holes, each of which contains just enough powder to make one grain or prism. This charger-plate is moved back and forth by means of the lever P, operated by the cam Q, on the shaft B. The weight S serves to keep the lever T in contact with the cam Q. The cross-bar R is fixed at each end to the frame, and holds fixedly six sets of steel spindles, each set being composed of seven spindles slightly tapered towards the upper ends, and finally brought to a point. The punches *t t* are made fast to their respective cross-heads, and are drilled each with seven holes corresponding in size and position with the spindles which enter them. The spindles pass entirely through the lower punches, and project into the upper ones. The mold-bed C is firmly secured to the frame at each end, and is mortised to receive a bronze mold having seven vertical holes in it, hexagonal in cross-section, of the size of the prism to be formed. The cross-heads E F, with their punches, are worked by the same shaft B; the upper one has the longer arm of lever, so that it shall travel further and follow about 60° after the other.

The gearing and those parts of the machine which come in contact with the powder are made of bronze, except the spindles which form the holes in the prisms; these, as before stated, are made of steel for greater strength.

Twelve of these machines are placed in the same building, in two rows of six each quite close together. A shaft, X, is run along the line of machines, near the floor, and motion is communicated to it by a water-wheel, the power being transmitted by wire ropes. The shaft X has two strong gears for each machine, and the wheels are speeded to make three revolutions per minute. The hopper O is filled with cannon-powder as it comes from the corning-mills, containing 6 per cent. of water, and of a specific gravity less than water.

The use of grain-powder is indispensable, as the meal-powder could not be measured out in sufficiently uniform charges to produce an even density, and the grains must be soft and contain considerable moisture to insure the entire obliteration of the granular structure of the pressed prism.

The holes in the charger-plate fill at once with powder and the plate is moved forward by the action of the cam Q, the lower edge of the hopper scraping off all powder from the top of the plate, and measuring out a given measure of charge each time, until the holes come over the molds, when the charges drop into them, the lower end being closed by the lower set of punches.

The further motion of the shaft brings the charging plate back into the hopper, when the charger-holes at once fill up, and both sets of punches descend, the upper one the more rapidly. Presently the lower cross-head reaches its dead point, and for an instant remains stationary,

while the upper punches, continuing to descend, press the charges from above; the upper cross-head now reaches its dead point, and the lower punches rising press the charges from the under side, and then raise the prisms clear from the spindles until the top surface of the lower set of punches have reached their highest point and are flush with the top of the mold-bar; just at this time the advancing charging plate pushes the prisms gently from off the punches on to an inclined plane, from which they slide into a box placed to receive them; the lower punches commence to descend and make room in the molds for the next set of charges, which are pressed in the same manner.

A boy is placed at each machine with a cloth to keep clean from the dust of powder those parts of the machine where it is liable to collect.

The prisms are next taken to the drying-house, where they are kept for a month; or, when the weather is good, they are dried in the open air, that is, in a building provided with numerous doors and windows which are kept open, but without the aid of artificial heat. Here they will dry in the course of five weeks.

Thickness of prisms	1 inch.
Length between two parallel sides	1.336 inches.
Number of holes in each	7
Diameter of holes	.15 inch.
Distance between centers of holes	.4 inch.
Weight of prism when dry	600 grains.
Pressure on prisms	2,100 pounds per square inch.

Density of prisms varies from 1.65 to 1.75, according to the gun in which it is to be used; the latter density is for the 11-inch gun.

Cost per pound ..... 23 cents.

Prismatic powder is not glazed; it is said to resist the action of moisture better than ordinary powder. It is packed in boxes lined with paper, the prisms laid on their bases, close together, so they cannot move, and covered with felt. This kind of powder is not made at either of the other mills.

In filling cartridges with prismatic powder, pains is taken to pack the prisms in the bag laid on their bases, fitting as closely as they can be packed, the holes in the prisms corresponding with those above and below, and forming air-passages for the communication of the flame through the whole length of the cartridge. The cartridge-bag is tied closely over the powder, fitting it snugly, and keeping the prisms in their places.

Prismatic powder is used exclusively for all guns of a caliber of 8 inches and over. For 6-inch guns it is sometimes used, but not invariably, ordinary cannon-powder being also occasionally used, though less frequently than prismatic. Ordinary cannon-powder is used for all field-guns and those of less caliber than 6 inches.

All powder is proved by firing service-charges and determining the initial velocity of the ball. Ordinary cannon-powder is proved in a 4-pounder gun, the prismatic in an 8-inch gun. The pressure exerted on the bore of the gun by the prismatic powder is also determined.

Martin de Brettes and Le Boulengé chronographs and the Navez-Leurs pendulum are used for determining velocities, and Rodman's pressure-gauge for the pressures.

The density of powder is determined by the mercury-densimeter.

The Ohktenskoi mills are under the direction of a major-general of

artillery, assisted by a colonel and four junior officers. The different practical operations are under the personal supervision of persons educated for the purpose at the school of technology.

An artillery force of 1,000 men is stationed at the mills, and serve as guards, but the employés are now all civilians, where formerly they were all soldiers.

In the latitude of St. Petersburg the cold weather, during which it is not possible to work without artificial heat, lasts for so long a time that there is about one-half of the year that the mills have to remain idle.

It is only from the middle of April to the end of September that the mills can be run. The long days of summer in that latitude render it practicable, however, and advantage is taken of it, to employ two gangs of workmen, and by this means the annual product of the mills is greatly increased.

During the winter the officers are occupied in making experiments.

The annual product of these mills, including powders of all descriptions, is about four millions and a half pounds, if worked to their highest capacity.

Wiener powder.

Colonel Wiener, of the Russian artillery, caused to be patented in this country, early in 1874, a new process of making gunpowder, which it is claimed is superior to that made in the ordinary way, whilst the process itself is much simpler, safer, more expeditious, and cheaper. The peculiarity of the process consists in its entire exclusion of water, and the substitution of heat, in forming the press-cake.

The materials are pulverized and incorporated in barrels with bronze balls, and thence transferred to the press for forming the cake, the press being so arranged that the composition may be brought in the operation to a temperature of 240° F., the melting point of sulphur. The cake thus obtained is broken into grains in the usual way. The powder made by this process is almost entirely free from dust; it absorbs not more than one-half as much moisture from like exposures; its force is greater, and its action more uniform. The saving that will be effected will be, as is readily seen, considerable—estimated to be about 40 per cent.—when it is borne in mind that the operation of incorporating the materials under the wheels, a slow and expensive one, and that of drying the powder, are entirely done away with.

As it is well known that the variable quantity of water used in the fabrication of gunpowder is the cause of variations in the strength of the product, and that gunpowder made of charcoal which has been permitted before being used to absorb moisture, is unfit for such purpose, it would seem to be in accordance with reason to expect that a powder made by a process which eliminates these causes of variation would be both stronger and more uniform than that made by the old way. The claim put forward by Colonel Wiener, that his powder is much stronger than ordinary gunpowder, appears to be borne out by the report of Colonel Struve, the engineer in charge of the construction of the permanent Liteiny bridge across the Neva at St. Petersburg. He states that in driving piles by means of a gunpowder pile-driver of Shaw's plan, the gunpowder charges prepared from Colonel Wiener's powder gave favorable results as compared with the government powder made of the same materials, being almost twice as effective. It has been stated that the Russian government is going to change the machinery of its mills, to adapt them to the making of powder on this system.

NOTE.—Samples of powder made by Colonel Wiener's process were

sent by Russia to the Centennial Exhibition at Philadelphia, and had a place assigned to it in the highly interesting Russian exhibit.

GERMANY.

Gunpowder for the military service is made part at the royal powder-mills of Spandau and Neisse, and part by private manufacturers in different parts of the empire, the standard of quality being regulated by the former.

The powder-works at Spandau were the only ones visited. They are of very ancient date, a pounding-mill having been established here as early as the year 1344. They are situated on low ground on the banks of the Spree, in the midst of a wood only a short distance from the arsenal on the opposite side of the river. The buildings, mainly of wood, are placed at considerable distances from each other, and the roads leading from one to another are covered with tan-bark to avoid the introduction of sand or gravel into the buildings, carried on the feet of the workmen. Water-power is the motor used to drive the machinery, with the exception of one steam-engine which drives the fan for forcing hot air into the drying-house some distance off, the boiler furnishing the means of heating the air.

Few changes have been made in the manner of making powder within the last fifty years or more. The method of incorporating the materials known as the "revolutionary process," from its having been adopted during the war of the French Revolution, though given up by every other nation, has been adhered to with only slight modifications. By this method the materials are pulverized and incorporated by being rolled in barrels turning on horizontal axes, and containing besides a quantity of bronze balls of small size. The composition is pressed into cake by means of two rollers between which it is made to pass, being first evenly distributed on an endless band of coarse linen. The upper roller is of bronze, and its pressure on the lower roller is increased and regulated by a weighted lever. The woods used for making the charcoal are the berry-bearing alder and willow, which are cut into lengths of about a foot, from branches about an inch in diameter. The distillation is conducted in cylindrical iron retorts into which the wood is closely packed and then sealed. The retorts are provided with small wheels for the convenience of running them in and out of the furnaces.

The fire is made in a grate beneath, and is in part sustained by burning the gases formed in carbonization, being conducted to the fire-place by means of iron pipes. The acid and tar are carried off in pipes to a reservoir prepared to receive them and are sold. Black coal is made for cannon-powder, and brown coal for powder to be used in the new model musket. From three to four hours are required to complete the carbonization. The saltpeter is obtained chiefly from the East Indies in the rough state, and is refined in the usual way at the works. The charcoal is pulverized alone in turning-barrels with bronze balls. The sulphur is pulverized in the same way, mixed with about an equal weight of saltpeter. The saltpeter prevents the sulphur from sticking, forming balls, and serves to facilitate the pulverization. The barrels are made of wood. The ingredients being pulverized are weighed out in the proportion of 76, 16, 10, and put in wooden barrels lined with sole-leather. With every 220 pounds of materials 300 pounds of bronze balls are added, and rolled from two to three hours, the barrels making from 8 to 10 revolutions per minute.

The composition is next taken in lots of 55 pounds to the moistening table, which is 7 feet long by 3¼ feet wide. Over it is suspended from

the ceiling a graduated glass vessel filled with water, with a rose for sprinkling attached to the bottom. Ten per cent. of water is mixed with the composition preparatory to forming it into cake. This is done by the roller-press. It consists of an upright wooden frame, with bearings for four iron axles in the same vertical plane, that for the top axle being free to rise or fall, the others stationary; four rollers, the top one of bronze, 23 inches in diameter, weighing 2,425 pounds, the next of metal, 7½ inches, and the last of wood, 2½ inches in diameter; a table secured to the front of the frame, holding a feed-hopper and small wooden roller, with a screw giving a horizontal motion to and from the frame for the purpose of tightening the belt which passes over it; a similar roller on the opposite side of the frame, and just under it two wooden boxes to receive the pressed cake and dust as it falls from the belt; an endless canvas belt, 20 inches wide, which passes between the two large rollers and around the three small wooden ones. The feed-hopper is larger at the base than on top. The endless belt passes through it close to the bottom, the side next to the frame slides up and down and graduates the thickness of the composition on the belt.

Motion is imparted from the shaft of a water-wheel to that of the smallest metal roller, which communicates it by friction to the paper roller in contact with it above and to the wooden roller below; the belt moves in the direction of the large roller from the feed-hopper. The composition is placed in the feed-hopper, and, falling on the belt, is carried in a layer of uniform thickness between the two rollers, the weight of the top one pressing the composition into a cake as it passes. A provision is made, by means of a lever and weights, by which the pressure of the roller is increased to 6,000 pounds. The pressed cake falls into a box from the belt where it changes its direction, and the operation continues as long as there is any composition in the feed-hopper. The large roller makes a revolution in about 12 minutes. The specific gravity of the cake, the pressure of the roller being the same, will be greater as the roller moves at a slower rate of speed.

The pressed cake is next broken into pieces with wooden mallets and put into the granulating machine. This consists of a horizontal frame suspended from the ceiling by means of cords; to this frame is fastened from 12 to 14 circular wooden boxes, each having several horizontal partitions, one over the other; the top one is made of hard wood or brass, perforated with holes .35 inch in diameter; the next is a wire sieve, the third a hair sieve, and the bottom of the box is board. The powder is placed above the frame in hoppers which communicate with the several boxes by means of canvas tubes. A disk of hard wood is placed in the first compartment. A horizontal circular motion is communicated to the frame and boxes by means of a double crank on a vertical shaft; and the disk of wood, moving back and forth, breaks up the powder-cake into small grains and forces them into the compartment below; the first sieve retains the larger grains, which constitute cannon powder, and are about the same size as that of our cannon powder. It passes out through a canvas tube into a box below provided for the purpose. The small grains, or musket powder, pass through the first sieve, are caught on the hair sieve, and pass out in the same way into another vessel prepared for it. The dust passing through the sieve is collected on the bottom of the boxes, and is removed from time to time as it accumulates.

The musket-powder is partially dried, and then carried back to the rolling-barrels and worked over again, undergoing exactly the same operation a second time.

After glazing, the powder is dried at a temperature of 190° F., being laid out for the purpose on thin canvas stretched over hot-water pipes, the hot air being forced up through the powder by means of a fan-blower. One hour and a half is sufficient to dry it. Its specific gravity is 1.64.

The process of manufacture of prismatic powder was obtained by Prussia from Russia, and for this reason was not open to inspection. We did not see it.

The prisms are 1 inch thick, and the diameter of the circumscribing circle is 1.57 inch. There are seven holes, one in the center and the others opposite the angles, the center .32 inch distant from the angle. The holes are tapering from .185 inch to .165 inch. Specific gravity 1.66. A prism weighs 587 grains. They are packed in boxes of 110 pounds each. To prevent the prisms from breaking, a piece of felt .4 inch thick is placed on top of the prisms and at the end of the box.

Prismatic powder is used in the 15-centimeter and all larger guns.

The workmen in the powder-mills either go barefoot or wear shoes with thick felt soles.

There has been a remarkable immunity from accidents at this mill. Only one man has been killed since 1832. This took place about a year before our visit, at the time when the use of brown coal was first introduced, and the accident was attributed to this cause. The daily product of the mills is from 6,000 to 7,000 pounds.

The Le Boulengé machine is used in the proof of powder to measure the velocity of the projectile.

Krupp's.

The powder used by Krupp in all of his large guns is of the prismatic form, made at Hamm, by a private manufacturer, after the Russian system. The size of the prisms is the same as used by Russia and Prussia, the density varying with the caliber of the gun in which it is to be used. For the 12-inch and 14-inch guns the prisms are perforated each by only a single hole instead of seven, and that is in the center; it is .59 inch in diameter. The specific gravity is from 1.73 to 1.76.

Schultze's granulated-wood powder.

Captain Schultze, of the Prussian army, in the course of his investigations some fifteen years ago into the properties of gun-cotton, with the view of determining its fitness for military purposes—a duty to which he was assigned by the war department—was led to propose a substitute for gun-cotton, and prepared a new explosive, which he claimed, after numerous and extensive trials, possessed great advantages in many ways over both gunpowder and gun-cotton. The process of manufacture is as follows: Wood is sawed with fine saws into thin veneers across the grain; these are cut into small cubes by means of a machine for the purpose. In this state it much resembles sawdust. The best woods are those generally used for gunpowder—the alder and buckthorn. They are preserved in water till used, that they may retain their toughness. The grains are first passed through several processes by which the acids and all soluble substances are removed, when they are ready for the acids. Nitric acid of 1.48 to 1.50 is mixed with sulphuric acid, specific gravity 1.84, in the proportion of 40 parts by weight of the former to 100 of the latter, and set aside to cool. Six parts of the prepared wood is then gradually added to 100 parts of the acids, stirring the whole constantly for two to three hours. A portion of the nitric acid combines

with the wood, the sulphuric acid unites with the water, and the nitric acid is thus retained in its original strength. The grains are next placed in a centrifugal drying-machine, which removes the surplus acid, and is then washed for a considerable time in cool running water. It is boiled in a weak solution of carbonate of soda, and again washed in running water and dried. The grains are now heated with saltpeter, or baryta nitrate, as is preferred for most varieties. They are now dried at a temperature of 90° to 112° F. for 12 to 18 hours, when they are ready for use.

It is manufactured in England and used in considerable quantities for sporting purposes, but has not been found to fill the requirements for military uses. It gives less recoil, smoke, and dirt than gunpowder.

FRANCE.

Important changes have been made in France during the last decade in the manufacture of gunpowder. The separate department for the management of the powder-mills and saltpeter-refineries has been abolished. The greater number of these establishments which were engaged in making sporting and mining powders has passed under the direction of the minister of finance; and five—Ripault, Bouchet, Saint Chamas, Angoulême, and Esquerdes—have been reserved for the manufacture of gunpowder for the army and navy.

Since 1865, the date of this change, all experiments on cannon-powder have been carried on exclusively by officers detailed for the purpose. The powder-mill of Bouchet has been completely under the orders of the marine in making experimental powders for large guns. Numerous and different powders, varying in the proportions of the ingredients, the mode and time of mixing, the density, size, and shape of grain, have been made and sent to Gâvre or Ruelle, to be fired from guns of proper size, and the effects on the projectile and the gun carefully noted. Similar trials have been made with foreign powders, such as the English pellet, the Russian and Dutch prismatic, the Wettern large grain, and powders made like them, and their effects carefully compared. The pressure on the bore of the gun was at first determined by means of Rodman's pressure-gauge, but trial having been made of certain powders which gave, according to this gauge, low strains, by firing them in a cast-iron gun of a certain model it was found that the gun burst on the fourteenth round, while similar guns, fired under the same circumstances, with powders which gave, with this gauge, indications of much greater strains, endured from thirty-five to sixty-two rounds. The pressure-gauge was deemed unreliable, and a new method of testing powders was adopted. It consists in firing to extremity a cast-iron gun of a given model, made of a particular iron, and treated in a given manner, with charges of a fixed weight of the powder under consideration. A new gun, made of the same iron, treated in the same way, is taken for each different kind of powder to be tested, and is fired till it is burst.

The initial velocity of the shot is measured; but no attempt is made to determine the pressure of the gases. The bore is carefully inspected and measured after every few rounds fired and the results recorded. The number of pieces into which the gun breaks, the lines of fracture, the number of rounds fired, and the velocity imparted to the projectile, serve to indicate the action of the powder, and determine its fitness for service.

In bursting, the chase is always left in one piece. With slow-burning powders the part in rear splits into two or three pieces, with one or more

cross-fractures, which do not pass through the threads of the screw in the breech. On the other hand, with quick powders the line of fracture is in the plane perpendicular to the axis of the gun, and passing through the bottom of the first thread of the screw, with other similar lines in front.*

This test of course proceeds on the hypothesis that it is possible, by the exercise of proper care in the selection and treatment of the iron, to make on the same model guns which shall not differ materially from each other in strength, so that if two guns thus made be fired under exactly the same circumstances in every particular except the quality of the powder used, any difference which may be found in their endurance will be due entirely to the powder and to nothing else. These trial-guns are not turned on the exterior, are breech-loading, and have the vent in the breech-block, in the prolongation of the axis of the gun, the bore and breech-block being identical with that of the service-gun of the same caliber.

Of all the powders experimented on, that which has given the best results in large guns is the large-grained powder made at the royal powder-mills of Wetteren, in Belgium, and accordingly all supplies required for the service of heavy guns up to the time of our visit were obtained from this source.

The pounding-mills, with their mortars and pestles, which have been so long used for incorporating the materials of gunpowder, have at last given place to the wheel-mill, in spite of the objections made to its use. It was found to be impossible to make powder suitable for the new material by this process, and a change has been also made in the proportions of the ingredients, and the formula used by most other nations has been adopted.

France has acted to a greater extent than any other power on the principle that every gun has its particular powder, which will do in this gun more work than any other, and has accordingly prescribed the size of grain for the powder to be used in each of the large calibers. The sizes adopted are, for the—

14-centimeter gun, between .275 inch and .3937 inch.

19 and 24 centimeter gun, between .51 inch and .63 inch.

27-centimeter gun, between .63 inch and .787 inch.

At Ruelle we witnessed some firing with a 27-centimeter (10.6-inch) gun for testing experimental powders. The gun was a breech-loader, and was fired with a charge of 79.37 pounds and an oblong projectile weighing 485 pounds.

The commanding officer of the Bouchet powder-mill was charged with the duty of getting up a powder which should give as favorable results in large guns as that procured from Wetteren. Following the process suggested by Captain Castan, the effort was entirely successful, as was shown by the satisfactory report made on it by the commission at Gâvre, where it was tested. The form given to the grain is that of a flat parallelopipedon, the thickness of which is the same as that of the pressed cake.

A large grain powder has also been made, suitable for the field-artillery, and another for siege-guns. The latter has grains .43 inch thick and a density of 1.79. It gives as high a velocity as the compressed rings previously used, with a less pressure on the bore of the gun.

* NOTE.—The initial velocity of the projectile is the same whether the bore be rifled or not, but the strength of the gun is much diminished by the grooves. Thus smooth-bores endure 95 rounds with ordinary cannon-powder, while rifled guns, similar in every respect, burst at the fifteenth or sixteenth round with the same powder.

Wetteren.

The royal powder-mills at Wetteren are situated on the Scheldt, near Ghent, and occupy over 27 acres, surrounded by a wide, deep ditch, which may be filled with water from the Scheldt at high tide, and drained at low tide by means of a canal and flood-gates constructed for this purpose. It employs 250 workmen.

The charcoal is prepared from the berry-bearing alder, a kind of buckthorn which grows in damp forests, the wood of which is acknowledged to be the best of all for the manufacture of gunpowder. The process of preparing the charcoal is peculiar, and is said to produce coal of the best quality. The distillation is effected by means of superheated steam. The wood is placed in a wrought-iron cylinder, the end of which is tightly closed and securely held by clamp-screws. Steam is carried in a thick wrought-iron pipe from a boiler to the fire-place of the boiler, where, making several turns in contact with the flames, its temperature is raised to 500° F. or 570° F. It is then introduced by means of a stop-cock into the cylinder which contains the wood to be carbonized. The hot steam quickly penetrates the pores of the wood, dissolves and drives out the sap, pyroligneous acid and tar, which are formed at this high temperature. These are permitted to escape as desired by means of a stop-cock and pipe, which conducts the gases and vapors into the flue of the chimney, or by another pipe into a condenser, from which the gases are conducted into the fire-place and are burned, to assist keeping up the fire under the boiler, and thereby economize fuel. The quality of the charcoal, whether that of the red or the more thoroughly-burned black coal, will depend upon the less or greater time the wood is subjected to the action of the steam in the cylinder, and its temperature. The operation can be stopped at any moment by closing the cock which lets on the steam. The charcoal is taken out and put quickly into copper coolers, where it is kept till it has entirely cooled off. The proportion of ingredients used is, 73.775 saltpeter, 12.020 sulphur, 14.205 charcoal. The saltpeter, with a proportion of charcoal, is pulverized in wrought-iron barrels containing an equal weight of bronze balls, and making 24 revolutions per minute. The sulphur has likewise a portion of charcoal added to it, and is pulverized in the same way. These two compositions are then put together in the proper proportions, and are mixed in leather barrels with an equal weight of bronze balls. After running in the barrels for one hour, the materials are transferred to the wheel-mill, where they are still further incorporated, each charge of 55 pounds being for two hours under stone wheels weighing from 22,000 to 26,000 pounds the pair, and making from 5 to 6 revolutions per minute.

The other operations have in them nothing peculiar, and call for no special mention.

AUSTRIA.

Austria obtains her supply of powder partly from mills belonging to the Government, and partly from private contractors.

For the reason of the shortness of our time and the fact that no great deal had been done in making powder for large guns, we did not visit any of the powder-mills in this country. Experiments had been made with prismatic powder with the usual favorable results, but the expense of manufacture led to the search by experiment for a less costly powder which should meet the requirements of the service.

In 1873, trials were made with pebble-powder of English make, and

samples made at Stein,* with grains of different sizes and density. The results showed the practicability of varying the grain in size and density so as to produce a powder which shall give in the gun for which it was intended satisfactory ballistic effects with little fatigue to the gun. The experiments have not yet been concluded. Trials have been made with the Castan powder with good results. All of the dense powders thus far tried have given, with velocities equal to those given by the prismatic powder, considerably less strain on the gun. These powders have a specific gravity of 1.759 to 1.785. The proportions of the constituents used are 74, 10, 16, and the incorporation is effected by means of the wheel-mill.

GUN-COTTON.

The prevailing sentiment in military circles on the continent is adverse to the use of this powerful explosive. This opinion is based on the belief that the substance is not a stable one, but is liable, under the ordinary circumstances attending its use for military purposes, to spontaneous combustion. A claim for reliable stability was set up for it in 1862 by Baron General Von Leuk, who contended that gun-cotton when carefully prepared and thoroughly cleansed from all remaining free acid is as stable a compound as gunpowder; but the subsequent explosion in Austria of a magazine, in which both gunpowder and gun-cotton were stored, did not fail to excite suspicions against the latter as being in some way implicated in the explosion, which could not be otherwise satisfactorily explained, to turn the tide of public opinion against the new compound, and confirm the doubts which had previously existed, whether it possessed in a sufficient degree the quality of stability, without which it could not be trusted.

The experiments commenced in 1863 by direction of the English government to test thoroughly, upon a large scale, the question whether gun-cotton, prepared after the process of General Leuk, possessed the required stability to warrant a sure confidence in its remaining indefinitely in an unchanged condition when subjected to all of the changes of temperature that it would meet with in actual service, have been so entirely satisfactory as to lead to its general use for destructive effects in mines, torpedoes, &c.

In order to remove all trace of free acid from the gun-cotton, which is an absolute essential in all cases, the process of General Von Leuk required long-continued washings in running water, sometimes extending over several weeks to accomplish thoroughly this prime requisite. The capillary action of the long fibers of the cotton formed a great barrier to the ready and complete removal of the acid, and consequently the operation of washing was a long, tedious, inconvenient, and uncertain one.

Professor Abel, the chemist of the War Department, to whom was committed the chemical and manufacturing part of the investigations, made several important improvements in the process of manufacture, chief of which is the reduction of the gun-cotton to a state of pulp. This, though originally adopted for another purpose, has much improved

*This powder-mill is situated near Laybach.

its quality, especially in regard to stability, which has been greatly assured by the more thorough and complete means of getting rid of the free acid, while the long washings in running water have been avoided, and the time required for the whole process of manufacture reduced from three or four weeks to as many days.

The terrific accident which occurred at Messrs. Prentiss's works at Stow-market in 1871, where gun-cotton was being manufactured for the government, and when 13½ tons were exploded, would have destroyed all confidence in its stability and caused its use for military purposes to be discarded forever after; but it was conclusively shown, after a thorough and searching examination into the causes of the accident, that the explosion did not result from spontaneous combustion of the gun-cotton as it came from the last operations of the manufacture, but was caused by impure gun-cotton, rendered so by acids which had been poured on it willfully by some unknown persons after it had passed through the finishing processes. The evidence taken at the examination is conclusive, and the experiments made in England, on which this evidence was based, go to inspire entire confidence in the stability of gun-cotton when it has been carefully prepared. Samples which have been subjected for eleven years or more to every degree and change of temperature that would be encountered in actual service in any known climate show no appearance of change, but remain in exactly the same state as when first made.

Experience has shown that in the manufacture of gun-cotton it is a matter of the greatest importance for the success of the process and the reliability of the product that the manufacture should be conducted with the greatest care and circumspection; and to secure this it is desirable that it be in the hands of responsible persons who have no interest in slighting any part of the work.

Impressed with the importance of adhering closely to the minutest detail in the different operations, the necessity for which was brought out clearly in the investigation above referred to, the English government determined to establish a gun-cotton factory under the immediate supervision of army officers, and accordingly one was established at Waltham Abbey, under the direction of the superintendent of the gunpowder mills.

In all of the various stages of manufacture the gun-cotton is in a wet state, entirely harmless, and the manipulations unattended with danger. It is not necessary, therefore, that the buildings should be removed at a great distance from each other, as in a gunpowder factory, but, for the convenience of furnishing the necessary power to drive the machinery, the buildings, built of brick, are placed near together, like ordinary shops, with a steam-engine for the motor.

The material required by Von Lenk's process for making gun-cotton was raw cotton of long staple and high quality; but Professor Abel prefers to all others the waste cuttings from spinning-machines, such as is used in workshops for cleaning machinery, for the reason that it has already undergone so thorough a cleansing in the process of spinning through which it has already passed it requires no further purification to prepare it, and the gun-cotton made from it is free from those impurities foreign to cellulose, which are removed from the raw cotton with so much difficulty, and are apt to form with the acids products of somewhat an indefinite and comparatively unstable nature, and become the initial points of any change or decomposition which might be started by long exposure to high temperatures. The points to be particularly attended to are to see that the waste is entirely free from

impurities, such as portions of seed-husks and foreign substances, and is thoroughly dry. The waste is received in bales, the cotton in a rough tangle. It is first picked over by hand, to remove all impurities that can be thus culled out, and is then passed through a machine, which, by means of toothed rollers, opens and loosens the cotton, and subjects it to the strong blast of a fan, which blows off other foreign matters.

Raw cotton at ordinary temperatures absorbs from the atmosphere about 6 per cent. of moisture. To remove this thoroughly the cotton-waste is subjected to a temperature of 126° for the space of 20 minutes. For this purpose a drying-chamber, long and narrow, is made of boiler-plate, covered over on all sides with a non-conductor, to keep in the heat, and for economy of labor and fuel is so arranged that its action shall be continuous and not require to be stopped to introduce or remove the cotton. It is heated by air which has just been in contact with coils of hot pipes, through which steam is kept circulating. The necessary ventilation is provided to carry off the moisture. It is provided with five horizontal endless belts running from one end of the chamber to the other, one above the other; to each of which is communicated a slow motion by machinery, acting by means of belts on pulleys outside of the chamber, fixed to the same axles as those on which the endless belts move. The cotton is fed by hand into a trough in the picking-room, and passes thence to an endless belt, which conveys it to the upper belt in the drying-chamber. This belt carries it through the length of the chamber and deposits it on the next lower belt, which performs a corresponding service, and so on to the last, which leaves it in a close closet prepared for its reception. The cotton, now thoroughly dry and warm, is weighed out in parcels of 1¼ pounds each; and, to prevent it from absorbing moisture from the air before it is used, (it cannot be dipped in the acids until it has cooled,) it is placed in tin boxes, with closely-fitting covers, and stored away until cool and ready for use. The acids are procured by contract from private manufacturers. It is particularly required that they should be in a highly concentrated state and of uniform specific gravity, the nitric acid 1.52 and the sulphuric acid 1.85. The presence of hyponitric acid in the former (from which, when concentrated, it is with difficulty eliminated) is not regarded as an objectionable impurity. The acids are thoroughly mixed together in the proportion of three of sulphuric to one of nitric, by putting a certain weight of nitric acid into one tank, and into another of equal height three times the weight of sulphuric acid. These two tanks are provided with outlet-pipes which will empty both tanks at the same time. These outlets are brought together into a single pipe, which conducts the acids to a considerable distance into a third tank, in which there is a mixer, to which motion is communicated by means of a pulley on the outside. After the acids are well mixed together, they are forced into tanks above the dipping-room, where they remain well covered for a considerable time before being used—in all cases until their temperature, which was raised by mingling the acids together, has been reduced to that of the atmosphere.

The immersion of the cotton in the acids gives rise to active chemical action. That of the nitric acid upon the cotton, and this with the union of the acids with the liberated water causes the evolution of considerable heat which it is necessary to control and regulate.

To carry off and keep down this heat, the vessels in which the cotton and acids are brought together are surrounded by cold water. A large deep trough extends along one side of the dipping-room, and a stream of running water is kept constantly passing through it. In this trough is

placed a long row of tanks, each some 14 inches wide, 2½ feet long, and 16 inches deep. These are kept filled with a certain measure of acid, into which the 1¼-pound charges of cotton are dipped. The partition-wall along the line of tanks has a row of holes cut in it, each large enough to pass a charge of cotton through it into the dipping-room. The holes are about 8 feet apart and are provided with close shutters, which are kept closed except when required for the delivery of cotton. Each workman is charged with three consecutive tanks, which he uses for dipping. He fills the first to a fixed height with the acids, raps on the shutter for a charge of cotton, which is passed by an attendant from the tin box in which it has been kept through the hole into a wooden scoop ready to receive it, from which the workman takes it and plunges it into the acid and leaves it there. He then proceeds to the second tank, and goes through the same operation, and afterward the third tank. By this time the cotton which was dipped first having been in the acids a sufficiently long time, is taken out with a long iron fork and laid on an open grate at the back of the tank, where as much of the acid is removed as can be pressed from it with the fork, using it for this purpose as a lever, and engaging the end under a cross-bar placed in rear of the grate. The charge of cotton is then placed in an earthern jar, covered with an overhanging cover of the same material, and deposited in the soaking-room, where it remains for twenty-four hours standing in a basin of water. The cotton has absorbed and taken with it about eleven times its weight of acids. The workman replaces this amount with fresh acid, immerses another charge of cotton in it, leaves it, and proceeds to the next tank to go through with the same manipulations as at the first, and so on to the others, taking each in its regular order of succession and going through exactly the same motions.

By this process of saturating the cotton in the acid the greater part of the former is converted into trinitro-cellulose, but there are generally some portions which escape, to a certain extent, this change; therefore, to insure the conversion of the entire mass, the cotton still containing an ample sufficiency of acids to continue the chemical action upon the fibers not yet acted upon is set away in earthen jars to give the necessary time to complete the change. A considerable amount of heat is still generated by this action, and, to carry it off and prevent its accumulation, the jars containing the dipped cotton are placed in cold water of a depth equal to three-fourths their height.

The soaking-room has its floor laid in concrete and cement, and is divided into several shallow basins, which will contain each about fifty jars, and are capable of being readily filled with water to a depth of 6 or 8 inches, and emptied at pleasure. The cotton is kept here for twenty-four hours, during which time especial pains must be taken to prevent in every way the addition of the least water to the cotton, as the result of such accident would be its ignition and entire consumption. In such cases strong nitrous acid fumes are evolved, and the jar is removed to the open air, where the cotton is quietly consumed without other damage than its loss.

The next operation is to get rid of the free acid contained in the cotton. This is effected, first by, means of the centrifugal drying-machine, which is 30 inches in diameter, and makes 1,500 revolutions per minute. The contents of five or six jars are emptied into the centrifugal machine, and the charge is uniformly distributed before the machine is set in motion. When the acid ceases to drop from the cotton the latter is taken out of the machine, and a greater portion of the remaining acid is removed and the chemical action arrested by washing in fresh water.

Care is to be taken at the first washing that the cotton is plunged quickly, in small quantities at a time, into a large body of fresh water, in order to avoid the danger of ignition. The first washing is performed in a large tub, in one end of which there is a wooden wheel which plunges the cotton, in small portions at a time, into the water, and submerges it at once. From this tub the cotton is taken to another centrifugal drying-machine, by which the water is removed, when it is again washed and dried in the same manner. The cotton is next carried to the pulping-machines to be reduced to pulp. These are essentially the same as the ordinary machines used for producing pulp for paper, and do their work in the same way.

The pulp next runs into the poaching-machine, where all of the remaining free acid is removed by continuous washings in fresh water, and finally at the close in water made slightly alkaline. The poaching-machine is a large trough, 24 feet long, 12 feet wide, and about 5 feet deep, with a large wooden wheel, like an ordinary water-wheel, of 2½ feet width of face, placed in the middle of, and parallel to, the longer side of the trough. Pipes are provided for furnishing a continuous supply of pure warm water and carrying off the surplus, as well as for conducting the pulp to and from the trough. A rotary motion is communicated to the wheel, which stirs up and keeps the pulp in constant commotion, dragging it down at one end and forcing it out at the other, at the same time assisted by workmen who, with long wooden scrapers, push it forward where it will meet the action of the wheel, thus bringing every particle in contact with fresh water and washing it in the most effetual manner. This operation is continued uninterruptedly, the water being constantly changed, until samples of the cotton will sustain satisfactorily a severe heat-test; this usually requires about 48 hours, though it may require 100 hours.

At least a half ton of gun-cotton is washed at one time in the poaching-machine, and by this means the products of many different dippings are most intimately mixed together, so that the greatest uniformity in the material is attained. Before being taken from the poaching-machine the gun-cotton is washed in water rendered slightly alkaline with the carbonate of lime and soda. It is desirable that the gun-cotton should contain as much as 3 per cent. of these mineral substances. The manufacture is now completed, so far as relates to the giving of the cotton its explosive properties and its resistance to further change under the ordinary circumstances of service and use.

Great care is required, even to the minutest detail of manufacture, to insure a product of uniform quality, and it is insisted upon that too much stress cannot be laid upon the fact that deviations from the prescribed process, which may appear at first sight trivial, (such as a slight variation in the strength of the acids or the neglect of proper cooling arrangements,) are certain to lead to varieties in the gun-cotton produced affecting its explosive character or its stability, or both.

In order to control the explosive power of gun-cotton it is necessary to compress the pulp into homogeneous masses of required form and density. For mining purposes and for torpedoes it is formed into circular disks, 3 inches in diameter and 1.75 inches thick, of a density slightly greater than water at 60° F., between 1 and 1.003, and each disk has two holes bored through it about 0.2 inch in diameter. To form these disks the pulp is drawn from the poaching-machine into a large, close iron tank called the stuff-chest, which, for convenience of drawing off the pulp, is placed on a level above the machines used for pressing the disks. It is supported on iron columns about 9 feet high, and being also

on a higher level than the poaching-machine the pulp has to be raised into the stuff-chest by first exhausting the air from it. It is provided with a wooden wheel, which, in revolving, keeps the pulp stirred up in constant motion and prevents it from settling and separating from the water in which it is held suspended. A pipe in the bottom of the stuff-chest conducts the pulp into the machine for forming the disks. This machine is constructed on the same principle and worked in the same manner as that heretofore described for pressing pellet-powder. The mold-plate in this case is a large bronze cylinder, about 15 inches long, and has 36 holes about 2½ inches in diameter bored through it. It is stationary, and made fast to the frame of the machine. A corresponding number of closely-fitting bronze plungers enters these holes from below and closes them at the bottom. These plungers are made securely fast at their lower end to a plate which is moved up and down by a hydraulic press, and are pierced with small holes running through them parallel to their axis. The object of these holes is to afford a way of escape to the water in the pulp when it is subjected to a heavy pressure. These plungers are first partially withdrawn a certain distance, so that the molds shall contain a certain fixed volume; the latter then are filled to the top with pulp from the stuff-chest, and are closed on top by means of an overhead block. The plungers are now forced upward by the pumps, and the pulp is compressed into a solid cake, the water escaping from it through the plungers. The overhead block is then removed, and, the plungers continuing their upward motion, force the gun-cotton out of the molds in shapes of short, compact cylinders. They are then carried to the next machine, which is similar to the first, except it has only four molds, 3 inches in diameter; in each of these three cylinders of gun-cotton are placed, separated from each other by circular iron plates, the edges of which are cut obliquely, with shallow channels to permit the water in the cotton to find its way out. The pressure brought to bear on each plunger is 15 tons, and the short cylinders of gun-cotton are pressed into disks 3 inches in diameter, 1.75 inches thick, and weigh 9 ounces each. The gun-cotton still contains 20 per cent. of moisture, and can be sawed or bored with perfect safety, or placed in the flame of a candle, or bored with a red-hot iron without danger. Each disk is bored with two holes about 0.2 inch in diameter, parallel to the axis, and disposed symmetrically on either side of it.

Gun-cotton is packed in water-tight boxes, containing about 20 pounds each. As many disks are put in as the box will hold, which is then filled with water, and permitted to stand for some minutes, when it is poured off and the cover securely screwed down. It may be kept with entire safety in this condition for an indefinite period, and be transported without danger or fear of accident, in any conveyance, having in this respect the advantage over gunpowder or most other explosives.

The discovery made by Professor Abel, that wet gun-cotton can be fired with the same effect as if it were dry, if there be present a small portion of the dry cotton, and it be exploded by a detonating fuse, is a most valuable one, inasmuch as it obviates the necessity of drying it, the only operation in the process of manufacture that is attended with any danger. Besides, it diminishes the liability to accidents in transportation and in use, as the damp cotton is perfectly uninflammable so long as it remains damp. It is necessary to dry only a disk or two for each separate mass to be exploded, and this may be done safely on hot plates which are freely open to the air at the sides.

The factory at Waltham Abbey has the capacity to turn out 4,000

pounds per day, and were making at the time of our visit 1,500 pounds per day. The cost of manufacture is stated to be 42½ cents per pound. Experiments * are being made to test its fitness for bursting-charges for shells and rocket-heads, for which purposes it is thought to possess advantages over gunpowder.

FIELD-CARRIAGES.

A marked change has been made within the last few years in the fabrication of carriages for field and mountain artillery.

The principal nations have arrived in quick succession at the same conclusion with reference to the material of which these carriages should be made, and have already abandoned the use of wood except for the spokes and felloes of the wheels, and for poles, and substituted in its place wrought iron or steel. The consideration which has led to this important modification is the superior strength, serviceability, and ultimate economy of the wrought-iron carriage. The general plan of construction adopted is much the same in all countries, and the carriages differ only in minor details, which vary according to the different ideas of taste and convenience, or as influenced by long-established usage.

The cheek and side of the trail are formed of one piece of boiler-plate, cut into the required shape and strengthened by angle-iron riveted to it around its outer edge, or made in one piece in a die, with the flange struck up while the metal is hot. The two pieces constituting the trail are joined together by the necessary transom and bolts, and by the lunette, which is riveted to both. The trail is further strengthened by the transoms forming the two ends of the trail tool-chest. The two pieces which form the sides of the trail slope from the head of the cheeks or from a point a short distance in rear of it to the lunette, and at the same time diminish in depth. The angle-iron which is riveted to the cheeks to strengthen and stiffen them forms also the trunnion-beds, and is placed sometimes on the outside and sometimes on the inside of the plate. The elevating-screw is arranged differently in different services. Minor differences will be mentioned in describing the carriages in detail.

AUSTRIAN.—(Plate IV.)

The 3.42-inch gun-carriage is composed of two cheeks of sheet-steel .24 inch thick, re-enforced around the edge by an angle-iron .275 inch thick, the flange turned inward. The cheek-plates are parallel for a short distance in rear of the axle; from that point they converge to the end of the trail, where they are secured to the lunette. The cheek-plates are joined by two sheet-iron transoms toward the front end, and between them a cylindrical transom under the trunnion-beds; near the middle is a sheet-iron transom forming one end of the tool-chest; and the bolts passing through the principal irons. In order that the piece may not be too low, and to assure its having a wide field of fire, the trunnion-beds have been raised considerably above the axle, and carried well forward.

The axle is cylindrical, of steel, with shoulders for the cheeks, to which it is secured by solid bands and understraps. It is provided with two seats, like the Prussian carriage, and is braced to the trail by two rods just inside of the shoulder-washer.

* NOTE.—These experiments have shown that gun-cotton can be safely used for bursting-charges in field-guns, and is far more effective for this purpose than gunpowder.

The elevating-screw is composed of two screws, one within the other. The outer one, which works in a fixed nut between the cheeks, has a rim-handle for turning it. The head of the inner screw is hinged to two iron rods secured to the cheeks.

The trail-handspike is secured to the socket, which is hinged to the support, so that the handspike can be turned down on the trail when it has been disengaged from the pointing-ring.

The wheels have metallic naves, and are smaller than ours; they are only 52.75 inches in diameter. Two shoes are used for locking the wheel, and are used in firing to check the recoil.

Limber.

The limber is composed of two trough-beams, 3.5 inches by 2 inches by .2 inch, secured directly to the axle by understraps, and bent at the front so as to form the fork; a transom and a socket for the pole joins them in front; they are connected in rear by an iron bar placed on top, which supports the end of a double T-piece of iron, 2.75 inches by 2.36 inches, the web 1.57 inches; this piece carries the pintle-hook. The splinter-bar is round, hollow, fastened under the fork by understraps, and secured to the axle by iron rods. The distance of the pintle-hook from the axle is considerably greater than is necessary to balance the pole, it would seem, and increases the weight of the limber. The pole is of wood, and can be readily taken out or put in place.

The ammunition-chests are of sheet-steel, .34 inch thick, and are divided by a principal vertical partition into two parts. Each part is in turn divided into six compartments by sheets of iron joined together, and strengthened by angle-irons at their junctions. The projectiles are packed in light wooden boxes, with cleats to keep them in place; the cover is held closed by a simple hook, and a handle is secured to it for withdrawing the box. The cartridges are placed in the compartments without doors. The chests are closed by two doors, which swing down around horizontal hinges placed on the lower edge of the chest; they are secured by means of a double turnbuckle attached to the principal partition, and by hooks near the ends of the chest. The handles of the chest are joined by a leather strap, and the rear part of the cover has a net-work for holding knapsacks. Three cannoneers can be seated on the front part of the chest. The limber-chest carries 34 rounds, of which 10 are shrapnel and 4 canisters, distributed as shown in the following diagram:

2 canisters. 6 cartridges.	10 cartridges.	10 cartridges.	2 canisters. 6 cartridges.
Implements and equipments.	5 double shells.	5 double shells.	Implements and equipments.
5 double shells.	5 shrapnel.	5 shrapnel.	5 double shells.

The two remaining charges are carried either in the trail-chest or in the rear chest of the caisson. The limber of the 3-inch cavalry gun contains 40 rounds, distributed as shown in the following table:

2 canisters. 8 cartridges.	12 cartridges.	12 cartridges.	2 canisters. 8 cartridges.
Implements and equipments.	6 double shells.	6 double shells.	Implements and equipments.
6 double shells.	6 shrapnel.	6 shrapnel.	6 double shells.

Principal weights and dimensions.

Weight of the gun	1,074	pounds.
Weight of the projectile	14	pounds.
Weight of the charge	3.3	pounds.
Initial velocity	1,476	feet.
Height of the axis of the trunnions	40	inches.
Width of the stock, front end	14½	inches.
Width of the stock at lunette	4½	inches.
Depth of the stock at elevating-screw	9.8	inches.
Depth of the stock at lunette	4½	inches.
Diameter of axle, the body	3.5	inches.
Diameter of axle at the shoulder	4.0	inches.
Diameter of the wheels	52½	inches.
Width of track	60	inches.
Weight of one wheel	197½	pounds.
Weight of carriage with wheels	1,190	pounds.

The caisson. (Plate V.)

The construction of the caisson is similar to that of the limber. It is composed essentially of a stock formed of two channel-beams 3.5 inches high and .2 inch thick, and two side-rails, also channel-beams, 2.75 inches high and .2 inch thick, bent in front to meet the stock, and joined at the rear by an iron bar. The caisson is provided with a brake, the cross-piece of which is a piece of round pipe suspended by a hinge from the side rails. The spare wheel is carried under the caisson in a horizontal position. The spare wheel-axle is attached to the stock by a hinge a little in front of the axle of the rear wheels; the wheel is lashed to the body of the caisson.

The ammunition-chest is constructed like that of the limber, but has double the capacity. It is made, so to say, like two limber-chests, placed one in rear of the other, and is closed by 4 doors, 2 in front and 2 in rear, opening around the lower horizontal edge of the chest. It contains 60 projectiles, 35 of which are double shells, 20 shrapnel, and 5 incendiary shells, with 64 cartridges of 3.3 pounds, and 32 cartridges of 1 pound for plunging fire. The cover of the chest is provided with a netting for carrying various articles. The advantages which result from this mode of construction of the chest and the arrangement of the doors, are so obvious as to make it needless to point them out.

The weights of the parts are as follows:

Weight of the—	Pounds.
Carriage with the gun and implements	2,264
Limber, packed	1,990
Caisson, packed	2,740
Gun with limber	4,255
Caisson, complete	4,731

The gun with its caisson carries a supply of ammunition of 128 rounds.

ENGLAND.—(Plate VI.)

The cheeks are made each of a frame of angle-iron of the required form, re-enforced by welding to it at the place where the trunnion-bed should come a solid piece of iron of a thickness equal to the width of the angle-irons, and large enough to cut out of it the semi-circular recess for the trunnion-bed, which is accomplished by means of a common band-saw. To the inner side of this frame a plate of boiler-iron of corresponding form is riveted. The cheeks are joined by two iron-plate transoms, one in front and the other in rear of the axle-body, by two bolts passing through iron pipes, and by the lunette. The cap-squares are secured by a chin-bolt which does not pass entirely through the cap-squares, and a pin which runs through the cheek and a hole in a lug welded to the under side of the cap-squares.

The elevating apparatus, which is known as the Whitworth pattern, consists of a long screw and bronze female screw with a bevel-gear cut on its lower surface. A spindle with a bevel-wheel on one end passes through the right cheek-piece, and has attached to it a bronze hand-wheel by which the screw is worked. The female screw and bevel-wheel are contained in a wrought-iron box having trunnions which support it between the sides of the trail; the journal-boxes are bolted on the inside of the trail-pieces. The elevating-screw admits of elevations of 21° and depressions of 4°. The 16-pounder gun-carriage has a trail-box of sheet-iron, divided into two compartments, for holding small tools. Its cover is fastened by a hasp and turn-buckle.

The axle and axle-body are of iron, and constitute a beam, in section a box-girder. The body is riveted to the axle, and also to the cheeks, by means of angle-irons.

Two wooden boxes, strengthened by corner-irons and provided with iron handles, are secured to the axle-body, one on each side of the gun, and carry each two rounds of canister. They also serve as seats for two gunners. A step for their feet is fastened to the box, and when not in use slides out of the way. A lock-shoe is used to check the motion of the carriage down hill, and the chain is arranged so as to allow the wheel, when it is desired to unlock it, to run over the shoe, which is then picked up and hung on the carriage.

The wheels (Plate VII) have bronze naves, which are in three pieces, the pipe-box being of harder metal than the two flanges. The felloes of ash and the spokes of oak, are made by machinery. The inner ends of the spokes are wedge-shaped, and form when driven a perfect arch around the pipe-box. The tenons are not of the same diameter throughout their length, but are larger at the shoulder, and fit in the fellies bored with two bits of different sizes. To assemble the wheel, the tenons of the spokes are entered in the holes in the felloes, and laid on a horizontal bed in the position in which they are to be put together, and by means of a hydraulic press arranged for the purpose the spokes are first firmly pressed home into the felloes, which are next forced close together. The

wheel is next taken to the shop to have the tire set. It is laid down on a platform covered with a plate of iron resting in a tank of water, in which the whole platform can be readily immersed. The tires are heated in a furnace, lying flat. When sufficiently hot, one is taken out and placed on the wheel, which has first been immersed in the tank. When the tire has been properly adjusted in position, the platform is sunk in the water until the tire has sufficiently cooled. In this way about one hundred tires can be set in a day. The ends of the spokes are next turned off to admit the pipe-box, which is forced into place; the two flanges are put on and firmly bolted together by triangular bolts passing between the spokes.

Limber.

The limber is formed of three futchells, an angle-stay, a splinter-bar, and two stays, an axle, axle-body, and pintle-hooks, all of iron, with foot-boards and shafts of wood. To diminish the weight thrown on the shaft-horse, the ammunition-chests are thrown well to the rear, and held by four knees of T-iron screwed to the rear side of the axle-bed. The limber is fitted for single, double, and treble draught, and by oxen.

Ammunition-chests.

Three chests are carried on the limber. Two of them are similar. They are all made of wood, strengthened by corner-pieces of iron. The side chests are partitioned off to carry 18 rounds of ammunition. The center chest has copper partitions, and carries fuses, friction-primers, &c.

Caisson.

The caisson is of iron, with the exception of the foot-boards. The stock is formed of two channel-beams. The spare wheel is carried on an arm secured to two plates riveted to the inner sides of the beams forming the stock, the plates being bolted together with bolts having pipes over them between the plates. A block of elm to act as a stay is riveted to the stock. The caisson-body carries four ammunition-chests and four under-boxes. The ammunition-chests are the same as the side chests on the limber, except in some of the leather fittings. A lock-shoe is used, the same as for the gun.

Principal weights and dimensions.

	9-pounder.	16-pounder.
Height of the axis of the trunnions above the ground	42 in.	43¼ in.
Pressure of trail on the ground	211 lbs.	266 lbs.
Weight of gun-carriage, empty	1,300 lbs.	1,480 lbs.
Weight of gun-carriage, packed	2,320 lbs.	2,957 lbs.
Weight on pintle-hook, without gunners	140 lbs.	147 lbs.
Weight of limber, empty	1,235 lbs.	1,270 lbs.
Weight of limber, packed	1,731 lbs.	1,792 lbs.
Weight of caisson, empty	2,725 lbs.	—— lbs.
Weight of caisson, packed	4,530 lbs.	4,660 lbs.

GERMANY.—(Plate VIII.)

The field-carriages are provided mainly by contract. Krupp makes the largest number. In his last model the cheek and trail-piece, instead of being strengthened by angle-iron riveted around the outer edge, is made of steel, and has this flange set up in a die while the metal is hot. The plates are first rolled to about the size required, then cut to the exact shape, heated to redness, and forced by means of hy-

draulic power into the die or former, which gives them the required form; that is, about 1½ inches of the edge of the plate all around is turned up like an angle iron. This necessitates the provision of an expensive former, but when it has been once prepared the expense of making the cheek-pieces is much diminished, while their weight for a given strength is considerably less than when the flange is riveted on. The cheeks are united by two plate transoms; that near the head of the cheeks is cut out so as to allow the gun to be depressed. The trail is further strengthened by the two ends of the trail-chest and the cover, which extends from the elevating-screw to the lunette, and by the different assembling-bolts. Each cheek is re-enforced by a system of braces secured to the inner faces between the flanges, and intended to prevent the trail from bending in firing. The axle is of tempered steel, and is cylindrical in the body. The arms are conical, and for a distance are flattened to hold the grease. The linch-pin is elliptical, and has a flat head, which may be used as a step. The wheels have bronze naves, 12 spokes and 6 felloes, of wood; their diameter is 55 inches, (4 inches less than the model of 1864.) The linch-washer is covered by a molding of the nave. Leather shoulder-washers are used to lessen the noise in marching. Two iron connecting-rods join the axles near the shoulder with the trail, strengthening the former. In the 9-centimeter these rods carry two seats for two gunners. The seats are provided with a back of netting, India-rubber springs to lessen the force of the shock going over rough roads, and a step for the convenience of the gunners taking their seats and to rest their feet on during the march. The carriage is provided with brakes, which are operated during the march by the gunners mounted on the axle-seats. The figure shows how these brakes are arranged; they may be also used to check the recoil in firing.

The elevating apparatus is composed of a double screw, (Fig. 12,) the inner one having a flat head with a hole drilled in it. The breech rests on a bronze block, which is embraced by the two rod-supports; they turn around a horizontal bolt passing through the cheeks near the head of the carriage. The head of the inner screw is hinged to the rods under the block. The outer screw has a wheel-handle for giving the elevation. A small chain attached to the trail-chest cover is used to fix this wheel in its position, and prevent it from turning during the march. The nut of the elevating-screw has trunnions which turn in trunnion-holes in the cheeks. The 8-centimeter gun-carriage will admit of elevations from 15° depression to 18° of elevation, and the 9-centimeter carriage from 15° depression to 16° of elevation.

Among the other irons of the carriage may be mentioned the trunnion-beds and cap-squares. These last are held in place by a vertical bolt, which passes through the flange, and serves as a handle for the man seated on the axle. The iron pointing-bar on the left cheek is movable around one of the lunette-bolts; it can be turned down to the rear, and rests on an iron fork on the cheeks. A case for grape-shot, with leather and felt lining, is on the left cheek, and on the right a sponge-ring near the axle-seat, and a sponge-socket near the lunette.

A short rammer is carried in the trail-chest. It is composed of a wooden head and a hollow iron staff. It is used in placing the projectile and cartridge in position; the staff has a mark on it for this purpose. The staff may be also used to open the breech when it sticks; it is engaged in the handle as a key.

Limber.—The wheels and axles are the same as for the carriage. Two parallel hounds embrace the pole at their front end, and are joined at

the rear by a transom, to which the pintle-hook is fastened. The latest pattern is made of iron, with the exception of the wheels and pole.

The ammunition-chest is of sheet-iron, and has on it two iron supports for a leather back-strap for the gunners. The rear side (that is to say, that which faces the gunner who is distributing the ammunition) has two rectangular openings, each provided with a door, which opens by turning down toward the rear. The doors are closed by means of hasps turning around the edge of the cover. An iron arc with two support-notches is attached to the right end of the cover and serves to hold it open.

Caisson.—Experimental caissons made of iron are now being tested with a view to their adoption.

Battery-wagon.—The body of the battery-wagon is cut out where the front wheels would strike it, so as to permit the wagon to make a short turn. The opening to the body is at the end, and the cover is provided with a wire railing to hold light articles which may be carried on the top.

Principal dimensions and weights.

	3.1-in.	3.464-in.
Height of the axis of the gun above the ground, inches	44.5	44.5
Weight of the carriage with trail hand-spike, pounds	1,080	1,157
Weight of the carriage with gun and implements, pounds	1,967	2,164
Weight of the trail on the ground, pounds	165	163
Weight of the limber not loaded, pounds	1,153	1,157
Weight of the ammunition, pounds	562	648
Weight of the tools, implements, &c., pounds	253	253
Weight of the limber loaded, pounds	1,969	2,060
Weight of the gun and carriage and limber without gunners, pounds	3,968	4,277
Weight of the gun and carriage and limber with 5 gunners, pounds	.....	5,015
Weight for each horse without gunners, pounds	660	712
Weight for each horse with gunners, pounds	.....	835
Preponderance of the end of the tongue without gunners, pounds	18.7	20
Weight of the caisson loaded for the batteries, pounds	4,696	4,940
Weight of the caisson loaded for the park, pounds	4,806	4,960

Ammunition carried.

Kind of chest.	For the 3.1-inch.					For the 3.464-inch.				
	Shells.	Shrapnels.	Canisters.	Number of rounds.	Cartridges.	Shells.	Shrapnels.	Canisters.	Number of rounds.	Cartridges.
Limber of the piece	24	12	2 and 1	39	42	20	10	2 and 1	33	35
Limber of the caisson	24	12	2	86	42	20	10	2	77	20
Rear chest of caisson	32	16	.....		48	30	15	.....		65

RUSSIAN.

This carriage is in its general construction like those already described. The cheeks are made of boiler-plate, .25 inch thick, and strengthened by angle-irons riveted around the edge. The axle is square in cross-section, 3 inches, and is strenthened to resist the recoil of the gun by a flat bar of iron bolted to it, the bolts not passing through the axle, but around it, and secured by nuts.

The wheels have bronze naves. Each felloe is bolted to the tire by a

bolt near each end. Under the heads of each pair of bolts nearest each other is an iron plate, let into the under side of the felloe, and serving as a washer to the bolt-heads, thus strengthening the wheel at the junction of the felloes.

The elevating-screw is a double one, and allows of an elevation of 20°. The carriages made ten years ago were constructed with a top-carriage, which had a lateral motion around a vertical pintle fastened to the axle of the carriage. By this means the gunner could point the gun without depending upon the man at the trail-handspike to give the exact direction. Experience showed, however, that the complication of the parts and the weakening of the carriage were not compensated for by the advantages gained, and this feature has been suppressed in the carriages of recent construction. The trail-handspike is wood, shod with iron, and made fast to a hinge on the trail of the carriage, so that it can be, when not in use, folded back on the trail.

The ammunition-cart is covered with sheet-iron, and lined on the inside with coarse tow-cloth, glued to the wood. More recently the cart has been superseded by the caisson with four wheels, drawn by horses attached for draught as in our service.

Among the regular stores assigned to each battery is a brass mold for casting new jackets on projectiles which have been fired and recovered. The Khivan campaign developed serious objections to the leaden coat, some of the pieces having been rendered temporarily unserviceable by the leading of the bore. To prevent this in future, the lead-coated projectiles are covered with a composition made of 25 parts of beef-tallow, 50 parts of common soap, and 25 parts of paraffine, applied with a brush. New projectiles are provided with copper bands for filling the grooves and imparting rotation.

Instead of woolen sponges for sponging the bore, brushes are used; the bristles are held in place by pitch. Brass-wire brushes have been tried, but their use has been abandoned.

Weight of gun, carriage, and limber, loaded, pioneers' tools and men's knapsacks included.	4,332 pounds for the 9-pounder. 3,660 pounds for the 4-pounder. 3,430 pounds for the horse-artillery.
Weight for each horse, including 5 cannoneers, mounted on the carriage and limber.	720 pounds for the 9-pounder. 600 pounds for the 4-pounder. 550 pounds for the horse-artillery

Colonel Englehardt's. (Plate IX.)

The great strain brought on the carriage by firing the large charges that are used in the new artillery renders the construction of the carriage a difficult problem, to be sure of the required strength without exceeding the limits of the weight hitherto deemed admissible, which cannot be exceeded without encountering grave objections in the service of the piece.

Already many attempts have been made to lessen the shock on the carriage by the introduction of springs of different forms, intended to give a certain elasticity and avoid breakage. A carriage of this kind was exhibited at Vienna by the Bochum Company. The desired elasticity was obtained by the use of a Brown's spiral spring, arranged somewhat in the same manner as in Colonel Englehardt's carriage. Metallic springs are, at best, frail, subject to accidents, and otherwise objectionable; consequently this carriage does not seem to have found favor.

Colonel Englehardt, of the artillery of the Imperial Guard, has exper-

imented in Russia on a carriage of this kind, which, it appears from the experiments made, has given highly satisfactory results. The carriage is distinguished by its simplicity of construction, and is composed essentially of two parts, the carriage proper, and the slide and wheels. The carriage is formed of two cheeks of sheet-iron, the edges formed up and joined together by a lunette and 4 transoms, two of which, *bb cc*, are between the cheeks, and two, *dd ff*, are in the trail; these last also form the ends of the trail-chest, in which the elastic cushion is placed. The different details of the construction are given in the figure, in which the elevating-apparatus is not shown; only the stays *p* and the journals for its trunnions are represented. It will be sufficient to point out in the drawing the iron plate *t*, a kind of spade, riveted and bolted to the end of the trail, intended to penetrate the ground when the carriage is in battery, and to check the recoil. The part which the inventor designates by the term slide embraces the axle A with the wheels; it is joined by two rods, not shown in the drawing, to a strong cross-head, *g*. The axle-understraps, as well as the hole in the trail for the cross-head, are sufficiently long to allow the pieces which work in them considerable play, so that the slide may move without imparting motion to the carriage. Under all other circumstances except violent shocks, produced by firing or by similar causes, the carriage and slide are united in an unalterable manner by means of an elastic cushion. This is composed of five strong sheets of cork, *h*, pressed between the transom *d* and a movable plate, *m*. The two strong bolts *i* pass through the whole and are secured to the cross-head, *g*. By turning the nuts on the ends of the bolts *i* any desirable initial compression may be brought on the sheets of cork.

When the gun is discharged the carriage, on account of the inertia of the slide, begins to slip, the resistance to which at the first moment brings into play the elasticity of the cork-cushion. The inventor hopes that as the carriage proper alone receives the shock of the discharge, the whole system will suffer less fatigue.

The carriage and slide weigh each 507 pounds, or 1,014 pounds for the complete carriage. The 9-c. (3.5-inch) gun, for which the carriage is intended, weighs 1,478 pounds, and throws a shell of 25¼ pounds.

This new carriage has been subjected successfully to the test of the following firings:

1st, 100 rounds with a charge of 2.7 pounds of ordinary cannon-powder, corresponding to an initial velocity of 1,098 feet. The recoil was completely stopped by the plate on the end of the trail firmly thrust into the ground.

2d, 20 rounds with a charge of 6.18 pounds of large-grain powder with an initial velocity of 1,335 feet.

3d, 160 rounds with a charge of 3.54 pounds of cannon-powder, with an initial velocity of 1,197 feet.

4th, finally, 660 rounds with a charge of 2.7 pounds, with a mean initial velocity of 1,082 feet, and a recoil of about 6½ feet.

In firing these 940 rounds the carriage sustained no damage whatever; the different parts performed their functions satisfactorily.

These tests of course do not correspond entirely as to the charges used and the velocities obtained, with the requirements made on the new artillery, but when we consider that in constructions of iron any weakness that may exist is usually developed after firing the first few rounds, and as the new carriage has shown no sign of yielding in any part in the 20 rounds giving a velocity of 1,335 feet, which approximates to what is regarded as necessary for field-pieces, it must be admitted that the possibility of constructing a carriage on this principle, such as shall fulfill all requirements, appears highly plausible.

FRANCE.

We had no opportunity of seeing any of the field-carriages used in the French service. It has been stated that it resembles much the latest pattern of Krupp's carriage, in which the cheek-piece and flange are one piece.

No details of the construction of the carriage have been published, so far as I have been able to hear.

SWEDISH. (Plate X.)

The Swedish carriage is made of boiler-plate a little less than ¼-inch thick, strengthened by angle-iron, both on the top and bottom edges, the angle-iron being turned inward.

The elevating screw is operated by means of a second screw, which turns the female screw of the former, thus raising or lowering the elevating screw.

The limber has the pintle some distance in rear of the axle, thus serving to balance the pole and relieve the weight from the horses' necks.

The hounds are made of two pieces of angle-iron riveted together, thus ⅂F

TRAVELING FORGES.

SWEDISH. (Plate XI.)

The construction of the field-forge is novel and peculiar. It makes an important departure from the long-established ideas on this subject, and, though not such as can be recommended in its details, the marked feature which makes it stand out in strong contrast with the forges used by other nations—the substitution of the rotary fan for the leathern bellows—is one deserving of consideration and imitation on our part.

The economy of space and weight in the forge, a matter of much importance, is considerable, and this too is gained without sacrificing efficiency.

The fire-pan is made of thick wrought-iron, and is provided with two strong hooks for supporting it from the end of the forge-box. It has also a copper pipe attached for conducting the blast from the fan to the fire-pan. The rotary fan is arranged in a portable box, which contains the necessary countershaft and pulley for increasing the speed and the means of adjusting the tightness of the belt. There is a small sliding window on the side to supply the air, and an orifice on the top, covered with a movable cap, for attaching the blast-pipe.

The tools and iron are carried in boxes which may be readily removed. The anvil, block, and fire-pan are carried loose. The supply of coal is carried in a chest on the limber, with an additional box for small tools.

The wheels for forge and limber are very low, being only 3 feet 6 inches in height, and quite light.

ENGLISH. (Plate XII.)

The field-forge consists of a rectangular frame of angle-iron, supported upon four legs also of angle iron, which fold under the frame when it is packed for the march. The fire-pan is supported over one end of the frame on collar-bolts, and has a back of plate-iron, hinged so as to fold down on the fire-pan when not in use. At the other end of the frame,

and hinged to it, is a rocking-staff frame to support the bellows, which rests in slots in the sides of the frame. The rocking-staff pivots on a tee-swivel on top of its frame. The forge-frame has four handles for convenience of handling. The water-trough is of sheet-iron, with flat hooks on the side to hang it to the fire-pan. The nail-anvil is secured by a nut to the frame of the wagon at the rear end on the near side. The vise when in use is fixed to the end of the splinter-bar.

The forge-frame, bellows, anvil and block, water-trough, &c., are carried on the march in an artillery wagon, the frame secured by two screws to the bottom of the wagon.

	Pounds.
Weight of bellows	77
Weight of forge, frame, &c	304½

MOUNTAIN-ARTILLERY CARRIAGES.

The carriage for the mountain-rifle is similar in material and general construction to that of the field-gun, and combines strength, simplicity, and lightness. The axle is without an axle-body, and the wheels have metal naves.

The Russian carriage has very short cheeks, the front ends of which are cut off obliquely instead of vertically; the trunnion-beds are let into this oblique face, and the trunnions are held by cap-squares and keys. Krupp makes two sizes of carriages for the 8-centimeter and 6-centimeter guns, respectively. The elevating-screw admits of 18° of elevation and 10° depression. The ammunition-chests are made of wood, with iron angle-pieces.

The English have two carriages (Plate XIII) for two 7-pounder guns, one of which weighs 150 pounds when made of steel, and 200 pounds if made of brass; the other weighs 200 pounds when made of steel, and 224 if made of bronze. The wheels are 30 inches and 36 inches in diameter, respectively, and have a track of 27 inches.

The elevating apparatus consists of a movable bed, which hooks on a cross-bar between the cheeks over the axle, and has two studs, one on each side, to rest in racks riveted to the inside of the trail-pieces. A sliding-quoin rests on the bed, and is worked by a screw which passes through a collar in the end of the bed and enters a nut in the quoin.

A light iron limber is made for the heavier carriage, and carries two ammunition-chests, which contain ten rounds of ammunition each.

In transportation the gun is carried in Russia and Germany over the horse's spine, the breech in front, this being deemed the more favorable position for passing narrow passes and the roads through which mountain artillery has frequently to make its way. The objection to having any part of the load crossways has induced the Russians to detach the axles for transportation, believing that the delays which may occur on the march from the axle-arms interfering with a free passage through woods, &c., would be greater than would result from having to adjust the axle to the carriage when it was required to commence firing. The carriage pack-saddle is provided with a rear pad to protect the animal's rump from blows from the end of the trail.

Principal weights and dimensions of Krupp's carriages.

	8-centimeter.	6-centimeter.
Weight of carriage with wheels	322 pounds.	178½ pounds.
Weight of gun with wedge	227 pounds.	198 pounds.
Weight of ammunition-chest, packed	103.6 pounds.	105½ pounds.

	8-centimeter.	6-centimeter.
Number of rounds in each chest	8	16
Weight of pack-saddle	46¼ pounds.	46¼ pounds.
Weight of powder-charge	14 ounces.	7 ounces.
Weight of shell, loaded	8 lbs. 13 oz.	4 lbs. 6½ oz.
Initial velocity of shell	952 feet.	919 feet.

English carriages.

	Pounds.
Weight of light carriage without wheels	161
Weight of light carriage with wheels	227
Weight of heavier carriage without wheels	192
Weight of heavier carriage with wheels	328
Weight of limber	333

SEACOAST AND GARRISON CARRIAGES.

Prior to the introduction of heavy charges and elongated projectiles for use in heavy guns, the chassis was of sufficient length that the recoil of the top carriage should be absorbed by its friction on the chassis-rails before the entire length of the latter had been traversed; but of late years, when the improvement in powder has been such as to render it a practicable thing to fire heavy charges with projectiles weighing two or three times the weight of a round shot of the same caliber, the increase in the recoil has become so great as to render it imperatively necessary to resort to other means by which it may be controlled within the limits of the chassis-rails. Different methods of more or less merit have been from time to time proposed. That of multiplied friction of numerous plates, or the compressor, as it was called, seemed for a time to find most favor throughout Europe until Captain Fraser, of the English navy, proposed the hydraulic buffer, and showed its successful practical operation, when soon after it was adopted by Krupp in the construction of his heavy carriages for Russia and Germany, since which time it has been generally adopted by every nation for heavy carriages to be used in the land-service, France, perhaps, excepted. Its simplicity and economy of construction, its efficiency, and its automatic operations are the features which commend it to general favor.

A hollow cylinder firmly fastened to the chassis, abutting the middle of the rear transom, a piston-rod secured to the top carriage and working in this cylinder, with four holes in the piston-head for the passage of the fluid which partly fills the cylinder, compose the essential parts of the hydraulic buffer as it has been universally adopted.

In some carriages made by Krupp for the German navy the cylinder, instead of being placed on the rear part of the chassis, against the rear transom, has been placed in front so that the piston-rod will be gradually pulled out of the cylinder instead of being thrust in, as is usually the case. It was supposed that for naval carriages there might be some advantages in this arrangement which did not apply to land-carriages, whereas the greater expense that necessarily attends its construction, and the greater difficulty of preventing leakage around the piston, has operated to prevent the adoption of this arrangement for other carriages.

The cost of the hydraulic buffer, as well as the weight added to the carriage, is less than those of the pneumatic buffer by about one-third.

GERMANY.

The heavy carriages for both the land and sea services are made, not in government shops under the directions of its own officers, but are

furnished by private parties who have granted to them in their contracts a wide latitude both as to the kind of material to be used as well as other matters of detail; they are not obliged to follow a given model or produce constructions which shall be nearly alike. The result is that the carriages constructed by different contractors are widely different from each other, though they may be intended for the same purpose and even for the same gun. An expression of opinion was heard in opposition to this system of procuring supplies, as it tended, or was so believed, to make the carriages in some cases heavier than were needed to perform the work required of them.

Some of the carriages built by Krupp for the navy have the cylinder for the hydraulic buffer placed on the front part of the chassis, so that the strain brought on the piston-rod shall be one of tension instead of compression. This disposition of the cylinder was suggested under the belief that in a ship's carriage, which is subjected to violent motions from the waves of the sea, the regular action of the carriage would be less interfered with when so constructed than when arranged in the ordinary way.

In carriages for the land-service these reasons do not obtain, and as this arrangement of the cylinder involves a greater cost of the carriage, and it is more difficult to prevent the loss of the fluid by leaking around the piston-rod where it passes through the head of the cylinder, this mode of construction has not been adopted.

The parties who have heretofore furnished nearly all of the heavy carriages are Krupp, of Essen, and Gruson, of Buckau, near Magdeburg.

Gruson's. (Plate XIV.)

Carriages for guns of 8-inch caliber only have been furnished by Gruson. They differ from the corresponding carriages made by Krupp in this essential particular that cast iron is used for several of the important parts in place of cast steel or wrought iron, and in consequence a cheaper but heavier carriage is made. The 8-inch guns are of two distinct classes, differing from each other in the distance between the rim-bases, being 35″ and 25.3″ respectively, and requiring separate carriages.

Top carriage.

The top carriage consists of two cheeks of cast iron, each in a single piece, with a rib on the outside extending around the edge and forming on the lower side a shoe which slides on the rail. The cheek is cut out in the middle to make it lighter, and is reinforced with a rib around the edge of the hole thus formed. The cheeks are connected together by two cast-iron transoms, front and rear, at right angles to the shoe, each held in place by two pins and three bolts. The spaces between the ends of the transoms and the cheeks are filled up with melted zinc, and whenever two pieces of cast iron are connected together without planing the surfaces melted zinc is poured into the space between them.

The front transom has a cross-head cast to it on its under side to operate the piston-rod, and guides to direct the motion of the top carriage on the rails. Guide-hooks are bolted on the under side of this transom to prevent any vertical motion of the top carriage and the bending of the piston-rod.

A sheet-iron step rests on two brackets which are bolted to the cheeks in rear of the rear transom for the man to stand on who elevates or depresses the gun.

The rib on the outside of the cheek forms a recess at the front and

rear corner for the truck-wheels, which are made of cast iron bushed with white metal, and provided with lubricating holes. The axle of the front roller is bolted to the cheek. The rear rollers are slightly larger than the front ones, and are mounted on an eccentric axle. The part of the axle which passes through the cheek is made larger than the rest and has a circular slot extending about a quarter of the circumference around it. A screw set in from the rear end of the cheek plays in this slot and acts as a stop to limit the turning of the axle, and also to prevent it from moving in the direction of its length. There is a hole in the axle on the inside of the cheek for the end of a handspike by which to turn the axle and throw the rollers in or out of gear.

The elevating-apparatus consists of a strong screw pivoted on a shaft secured to the left cheek, and a female screw of brass which is operated by means of four handles cast to the lower part of the female screw. India-rubber rings are interposed between the female screw and box to lessen the force of the shock of the recoil on the screw-box.

The top carriage for the smaller gun differs from that just described in this, that the cheeks are bent outwards at the bottom to preserve the same distance between the shoes in the two carriages, so that the same chassis may be used for either, and in having a different elevating apparatus.

The preponderance of these guns, 992 pounds, allows the application of a single elevating-screw under the breech of the gun, a female screw being fitted in a boss on the rear transom.

In order to obtain high angles of elevation without having a screw of very great length, a cast-iron cap is placed on the head of the screw between it and the gun, and is kept there for all angles of elevation less than 8°, which corresponds to a range of 3,280 yards.

Chassis.

The rails are 12-inch rolled beams, connected together by three transoms of boiler-plate, two at the front and one at the rear end. Wooden hurters are secured to the front end of the rails for the front truck-wheels to strike against. India-rubber counter-hurters are secured to the box-flange of the hydraulic cylinder, and are struck by the guides on the rear transom of the top carriage. The hydraulic cylinder is of cast iron, 75 inches long and 1.4 inches thick. It has a flange or seat cast on the bottom at each end for securing it to the bottom transom. The rear seat takes the form of an open box, the length equal to the distance between the rails to which it is bolted, as well as to the bottom-transom. The ends of the cylinder are turned off square, and are closed by cast-iron covers fitted closely and bolted to the cylinder, a piece of pasteboard saturated in linseed oil being interposed between the surfaces to make a close joint.

The front cover contains the stuffing-box, which is of brass. The rear cover has a recess in the inside, so that the nut on the end of the piston-rod shall not strike it. There is a gauge-cock in the center of this cover to regulate the height of the glycerine in the cylinder. The piston-head is of cast iron. The four holes in it are reamed out to be parabolic in section; the least diameter is .78 inch.

The traverse-wheels are of cast iron; the front ones are solid and smaller; the rear have spokes.

The sole is flat, and the front flange is much stronger than the rear one. The front flange of the rear wheel has holes in its periphery to

receive the end of a handspike to traverse the chassis in case the traversing-gear should fail to operate.

The traverse-wheel forks are also of cast iron. The front fork has no rear branch, the wheel being supported only on the front side.

The traversing-gear is held in a frame formed of two parallel iron plates bolted by means of angle-irons to the rear bottom transom. It consists of a large grooved wheel for the chain, and four guide-rollers; two with their axles horizontal are grooved like the large wheel; the others have their axles vertical. A large spur-wheel is shrunk on the nave of the chain-wheel, and is driven by a pinion and bevel-gears on a cross-shaft which is turned by a crank.

The projectile-crane consists of a crane-box of cast iron bolted to the outside of the right chassis rail. The crane proper is composed of two parts, the body, which is a round iron rod, and moves freely up and down in the circular hole in the crane-box, and the bent neck made of two flat bars riveted to the flattened upper end of the body. The neck has two fixed pulleys between the flat bars for the chain to work over. A straight rack is secured to the body at their upper ends, the end of the former being bent at a right angle to itself, with a circular hole in the bent end for the body of the crane to pass through. A shoulder on the top of the body rests on the rack where the body passes through the bent end. The rack is operated by means of a wheel and pinion turned by a crank. A chain with a hook on each end is fastened at one end to the crane-box, passes over the two pulleys, hangs from the end of the neck, and is fastened to the projectile-cart. In raising the crane the projectile is also raised by the shortening of that part of the chain which hangs from the upper roller.

The implements are the same as for Krupp's carriage, with the exception of the handspike, which is entirely of iron; and the traversing-gear has two cranks.

The weights of the two carriages are as follows:

	Krupp's.	Gruson's.
	Pounds.	*Pounds.*
Weight of top carriage	4,602	5,512
Weight of chassis	10,830	8,819
Total weight	15,432	14,331

Krupp's. (Plate XV.)

The top carriage is composed of two cheeks connected together by a front, rear, and bottom transom. The latter, of boiler-plate, extends under the bottom of the cheeks their entire length, and is shod on the under side where it comes in contact with the rails with brass shoes screwed fast to it.

The cheeks for the 6-inch gun are made of a single plate 1 inch thick. For the larger calibers they are made of two plates riveted together, with a wrought-iron frame between them; in the upper side of the frame the trunnion-beds are formed to receive the trunnions, which have bronze friction-rings fitted on them. Cap squares are used for all carriages.

Both cheeks are provided on their outer faces with an apparatus for giving the elevation. It is composed of a cog-wheel operating a circu-

lar rack fastened to the gun by a bronze stud. The rack is held in place engaged with the teeth of the cog-wheels by a small roller with its axis in the cheek.

To elevate or depress the gun there is a wheel on the left side, with holes in its periphery to take a handspike; and on the right side there is a wheel with handles. In carriages for heavy guns this wheel is not on the same axis as the cog-wheel, but works in a pinion to gain power to raise the gun. The gun is held in any desired position by turning a check-screw which presses the wheel against the cheek.

In firing, the top carriage rests on the chassis rail throughout the entire length of the shoe, in order to distribute the pressure arising from the discharge over a greater surface.

To run the gun into battery the top carriage is provided with four truck-wheels. The rear pair are on eccentric axles, and can be thrown in gear by turning the axles part way round; this brings the front wheels in play, which turn on fixed axles. In the 6-inch gun-carriage each pair of wheels has a common axle, which has its bearings in the two cheeks, and the wheels are close up to them on the inside.

The bottom transom has two openings left in it to allow the rear wheels to bear on the rails. The lever of the rear wheels on the left end of the axle is kept in position by a latch on the cheek.

In carriages for heavier guns, beginning with the 6.7-inch gun, the truck-wheels are placed between the two plates of the cheek, in front or rear of the frame. Each wheel has its own axle.

An automatic arrangement is made to run the gun into battery after firing, without any action on the part of the gunner. This device consists of two wedge-shaped pieces of iron screwed fast to the top of the rails in rear of the top carriage. When the gun recoils, the rear wheels run up these inclined planes, the rear end of the carriage is raised till the front wheels are brought to bear also, and after the recoil the carriage runs down the inclined planes into battery, ready for the next fire. The eccentric axle is kept from turning by a key in the cheek. To run the carriage from battery this key is taken out, and the wheels may be thrown in gear by turning the axle with a handspike in the handspike socket.

To provide for the possible wear of the front wheels, and preserve an equal and quick motion when running into battery, the front wheels are also mounted on axles with eccentric boxes, which are kept in position by a small screw in each. To make this adjustment, remove the screw and turn the box, which, on account of its eccentricity, will lower the axle; it is held in the new position by the screw placed in a second hole. Two angle-irons are fastened to the bottom transom to guide the top carriage in its recoil; and two guide-hooks which pass under the flange of the rail prevent the top carriage from balloting on it. India-rubber hurters and counter-hurters are provided to limit the recoil both to the front and rear. In the 6-inch carriage the hurters are replaced by the curve of the end of the angle-irons which join the bottom transom to the cheeks. Two rings are fastened to the rear end of the cheeks, near the bottom, to hook the ropes to for pulling the top carriage from battery.

The hydraulic buffer.

The hydraulic buffer is used to regulate and check the recoil of the gun. It consists of a forged cast-steel cylinder bored out and turned. Its rear end is closed by the bottom, screwed on and fastened to the rear transom of the chassis by screws. The front end of the cylinder is also

screwed into a piece to which the cover is held by screws. There is a hole in the bottom piece for filling the cylinder; it is stopped with a screw and a cock in the cover for emptying it. The piston-head, with four holes bored in it, fits the cylinder closely, and to it the piston-rod of cast steel is fastened, and passes through the cylinder-head, the joint being packed with hemp-packing and bronze packing-box. The end of the piston-rod is fastened to the cross-head, which is bolted to the bottom transom of the top carriage.

The hydraulic buffer operates in this manner: The cylinder is filled almost full with glycerine, which is preferable to water in that it does not evaporate or freeze. A certain amount of air is always left in the cylinder. In the recoil of the carriage the piston-head connected to it by the piston-rod and cross-head compresses the glycerine in the rear end of the cylinder, and causes the liquid to flow rapidly through the holes in the piston-head, gradually bringing the carriage to a state of rest. The air in the cylinder acts as a cushion when the gun is fired, and lessens the shock which is then communicated to the different parts. The resistance of the liquid to a slow motion of the piston-head being very small, no difficulty is experienced in running the gun slowly into battery.

The chassis.

The chassis is composed of two rails, connected together by transoms. The rails are wrought iron, I-shaped, rolled in a single piece for the smaller guns, and built up for the 11-inch gun, and all of larger caliber. The front transom is composed of two plates, the upper and lower joined together in the middle by cross-pieces of the same profile as the rails. The rear transom is also composed of an upper and lower plate, united by two cross-pieces riveted to the plates with angle-irons. The rear end of the hydraulic cylinder is bolted to the front one of these cross-pieces through an intermediate piece. The middle transom, composed of a plate, re-enforced with angle-irons, supports the front end of the cylinder, which is secured to it by its brace. The front and rear transoms of the 6-inch carriage are made of single plates, placed vertically, and re-enforced at top and bottom by angle-irons. The traverse-wheel forks are made fast to a front and rear bolster, which are bolted to the chassis.

Each bolster is composed of two vertical side plates, one horizontal plate and one vertical plate, with the necessary angle-irons to unite the parts together. The rear bolster is made enough higher than the front one that the four wheels may be all of the same size, notwithstanding the inclination of the chassis, which is necessary to make the gun run into battery after firing. The traverse-wheel forks, composed each of a front and rear branch, are bolted to the under side of the horizontal plate of the bolsters.

The traverse-wheels are of cast steel, with a deep semicircular groove cut in their periphery to fit over the traverse-circle, which is nearly semicircular in cross-section, so that a large part of the recoil of the chassis is transmitted directly to it. The rear wheels have several holes bored radially into them to receive the end of a handspike to traverse the carriage in giving the proper direction to the gun.

Hurters and counter-hurters are placed on the front and rear ends of the rails, or the front and rear transoms, to stop the carriage running into or from battery. These hurters are made each of a steel piston, fitting in a box, and holding, between the head and box, a number of India-rubber disks, separated from each other by sheet-iron rings.

A hinged tongue, bolted to the front transom of the chassis, connects it to the pintle in front.

A windlass, attached to the rear end of the chassis, is used to run the gun from battery. It has a drum with raised sides for the rope, and is operated by a crank turning a wheel and pinion. For guns of very large caliber a double set of wheels and pinions is added between the crank and drum. All of these parts are fastened to a stirrup, which is secured by means of a tenon to the rear end of the rail. To run the gun from battery, hook the ropes on each side to the rings in the top carriage, take a turn around the drum, tighten the ropes and work the cranks. In the carriage for the 6-inch gun the arrangement is replaced by a simple block-and-tackle, which is hooked in the rings in the rear end of the chassis.

In the other carriages these rings are fastened to the windlass-frame, and are also used in traversing the carriage. For this purpose, commencing with the 8-inch sea-coast carriage, a windlass is used, fastened to the rear end of the chassis by a boiler-plate frame, strengthened by angle-irons, to which all of the movable parts are attached. The principal part is the drum, around the circumference of which the chain works, fastened at its two ends to rings outside the platform. A pair of horizontal and vertical leading wheels on each side prevent the chain from leaving the drum. If the drum be turned by means of the crank which communicates with it through the wheel and pinion, the drum moves on the stationary chain, traversing the chassis with an easy but rapid enough motion. In case the chain breaks, the chassis may be traversed with handspikes. A crane is provided for the heavy carriages, commencing with the 8-inch, for raising the projectile. It is placed on the right side of the chassis, on a line with the breech of the gun, when in battery. It consists of a curved iron upright, which is held in a vertical position by a pillow-block and collar, and is readily turned by the handle. The drum is near the foot of the upright. By turning the crank, motion is given to the rope, either directly or by a wheel and pinion. One end of the rope is fastened to the drum, and thence it passes over two fixed pulleys on the upright. The other end has a hook fastened to it. This hook is inserted in the upper ring of the shot-cart, which, holding the projectile, is hoisted up, the tongue being first taken out. The crane is turned until the carriage touches the gun, to which it is hooked. The shot being rammed home, the crane is turned, and the empty cart is lowered.

Steps are attached to the chassis at several places for the convenience of the gunners, (angle-irons are fastened to the rails, and oak plank are secured to them,) as the step for the gunner in pointing in rear and across the chassis, on both sides of the chassis and between the rails, for the men serving the gun, inserting the projectile, the charge, &c.

The platform.

The foundation is made of brick masonry, from 3 to 6 feet thick, according to the caliber of the gun. The stability of the foundation being the essential condition of the continued good working of the carriage, the masonry should first of all have a solid bed. If the soil be not firm, as often happens on the sea-coast, the foundation should be made by driving piles, on which a good bed of concrete should be laid, and may be made still more solid by pieces of railroad iron.

First, the pintle-plate, drilled out to receive the pintle, is laid on the masonry, and bolted down to cast-iron plates and ribs anchored in the

masonry. The front traverse-circle is bolted down to the base of the pintle-plate, which is enlarged to the rear for this purpose. The rear traverse-circle, composed of two parts, is bolted down, for guns of large caliber, to a cast-iron rail imbedded with cement in the foundation.

The length of the traverse-circles is generally calculated for a field of fire of 45° on each side of the central line. The traverse-circles for small guns are screwed down to chairs inserted in holes made in the masonry, and secured there by means of melted lead poured in. The pintle-plate, with the front traverse-circle, as well as the rear traverse-circle, may be laid down on temporary wooden platforms.

The windlass-chain is placed on the platform in rear of the rear traverse-circle. Five metal plates are let in the masonry; the two extreme ones have rings to which are fastened the ends of the chain, and three intermediate ones are provided with eyebolts. These bolts are so placed that they will keep the chain in its nearly circular position by their bent heads without presenting any obstacle to the windlass-wheels which travel in rear.

IMPLEMENTS.

The following implements are supplied for sea-coast carriages: Two wooden handspikes, (ash,) the ends shod with iron and made to fit in the holes of the elevating-wheel, in the rear truck-wheels, and rear traverse-wheels; a wrench for the packing-box; a wrench for the cock and the filling-hole screw in the hydraulic cylinder; a screw-wrench, and a shot-cart. The body of the cart is a piece of curved sheet-iron, on which the projectile lies. It is held in place by an iron strap passing over it, through which two screws pass and press against the shot between two bands. An eyebolt and ring is provided on the top of this strap, into which the hook of the crane-rope is passed to hoist the shot. The front end of the cart has a flange, with two hooks to hang it to the breech of the gun, where it rests and serves as a guide in loading. The axle and two bronze wheels are placed a little in front of the center of gravity, and a sheet-iron prop at the rear end, and also the pole, which can be taken off, but is held in place when in use by two hooks below and two studs above.

To load the cart, the projectile is first placed on its base and the cart over it; the screws for holding the projectile are turned down; the cart is then righted and the pole put in place.

For every battery, or in large batteries for every three guns, there is added a pair of windlasses like that already described and used in running the top carriage back, and a funnel with a graduated scale inside giving its contents in gallons. Its bottom orifice is closed by a cock, and is used in filling the cylinder with glycerine.

An extra block and tackle is added to those carriages which have no windlasses.

PLACING IN POSITION AND MANOEUVRING.

The carriages having been all mounted and proved in the shops by firing and working them, it is only required for mounting them in battery that the corresponding parts should be secured to the platform, which should be level and firm. The pintle-plate should be laid down so that the pintle shall be exactly vertical. The rear traverse-circles should be placed on the arc of a circle described with the pintle as a center, and a mean radius of 15 feet, for all sea-coast carriages from 6 to 11 inch caliber.

The heads of the screws in the traverse-circles should be well sunk. The hooks for the windlass-chain should be turned outwards in line with the radius, and placed so that the lower windlass-wheels may pass ¾ inch in rear of them. To adjust the chain in the hooks the chassis is placed about the middle of the platform, one end of the chain is made fast to an end ring and is then passed over the leading wheels and drum, drawn tight, and the other end is fastened to the corresponding end ring. Great care must be taken that the links do not get in the least twisted.

The hydraulic buffer should be the object of especial attention, although there is little to do to it after it has been secured in its place in the shops. First, attention should be paid to the preservation of the glycerine in the cylinder at its proper height, which can be discovered at the filling-hole. If the glycerine falls below the prescribed depth, no matter from what cause, it must be replenished. For this purpose, take out the filling-hole screw and insert the funnel in the hole. The purest glycerine is always to be preferred, of a density of 1.19, which neither evaporates nor freezes, even with the greatest cold, and has no action on the metals.

In cases of emergency the deficiency may be made up with pure water without altering its qualities sensibly, but this addition of water should never exceed one-fourth of the whole. In filling the cylinder the prescribed quantity marked in figures on the end should under no circumstances be exceeded. In some carriages the proper height of the glycerine is marked by a screw. To prevent it from leaking, it is absolutely necessary, in the first place, to keep the filling-hole screw always tight by wrapping it with a hempen thread, with white lead or tallow when necessary; secondly, to tighten the hemp packing whenever the least leaking of the liquid is observed, by screwing up the packing-gland; and, thirdly, to keep the emptying-cock always tight and well closed. It is advisable to close it with a wooden plug.

Before firing, the carriage, and particularly the hydraulic buffer, should, as far as possible, be minutely inspected, the bolts, nuts, &c., which may have got loose tightened up, and the working of the different parts tested.

During the firing, the working of the carriage should not, so far as circumstances will admit, be lost sight of. It is desirable, for example, that the recoil of the carriage, provided with the apparatus for bringing it back into battery automatically, should be so regulated that the rear wheels should be about an inch and a half in front of the end of the wedges on the rails. If the carriage stop farther to the rear, no matter from what cause, the best manner of remedying it is to put grease or oil just behind the front wheels; these wheels, moving back with the carriage, spread the grease over the whole surface of the rail. If the check in the recoil is caused by the wear of the front axle, and consequently the wheels do not bear sufficiently on the rails, it must be corrected by turning the eccentric axle-boxes which have been heretofore described. The top surface of the rail should be always kept clean and smooth, and in case ridges are formed they should be removed with a file. Should the chain or any part of the windlass break, the chain should be at once removed, and the carriage be traversed by handspikes inserted in the holes of the rear traverse-wheels, or by hitching a block and pulley to the rings in the rear end of the chassis.

Since the flanges of the traverse-wheels are able to stand the recoil of the chassis, and also to give it the necessary motion on the traverse-circles for training the carriage, the gun may be fired for some time in case of necessity without any pintle.

The 12-inch-gun carriage.

This carriage (see Plate XV) is similar in its general construction to those above described. It admits of an elevation of the gun of 17°, and a depression of 7°. The axis of the trunnion-beds is 93.7 inches above the platform. The elevating apparatus is provided with a wheel on either side of the carriage, having radial handles with which to operate it. This wheel carries a pinion, which is connected by an intermediate wheel to that which works the circular rack, thus gaining power to raise the breech. The rails have a depth of 17.7 inches, a width on top of 6.29 inches, and an inclination of 4°.

The piston-head of the hydraulic cylinder is pierced with four holes .76 inch in diameter; 19½ gallons is the maximum quantity of glycerine that should be put in the cylinder. The weight of the top carriage is 12,456 pounds; the chassis, 33,842 pounds.

The 14-inch-gun carriage

(see Plate XVI) differs from the 12-inch only in some minor details. The axis of the trunnion-beds is 105 inches above the platform. The carriage admits of the gun being fired over a parapet of 78 inches in height, with an elevation of 19° and a depression of 6°. A dial-train is attached to the circular rack of the elevating apparatus, and shows to the gunner working the wheel the degree of elevation given to the gun. The hydraulic buffer has two cylinders 9 inches interior diameter, in place of a single one. They are placed close to the rail on each side of the chassis. Three traverse-circles and three sets of traverse-wheels are used instead of two.

A graduated arc of a circle is traced on the platform in rear of the chassis, with a pointer fastened to the end of the rail to give direction to the gun when the object fired at cannot be seen on account of darkness, smoke, or fog. Weight of the top carriage and chassis, 74,961 pounds.

The German naval carriage. (Plate XVII.)

Carriages of this kind have been recently constructed for light guns and introduced into the German naval service. They belong to the class of truck-carriages, are light, easily moved into battery, take up but little space, and are provided with a circular friction brake, by which the recoil of the gun may be controlled at pleasure. A 6-inch gun, mounted on one of these carriages, was fired at Krupp's proof-grounds at the time we were visiting there. The carriage worked well, checking the recoil within a short distance.

As the principle on which the recoil is controlled may be as well used in the construction of some of the carriages for the land-service, it may not be out of place to give a short description of its leading peculiarities.

The cheeks are made of thick iron plates, each cheek of a single piece, re-inforced around the trunnion-holes by a semicircular plate of iron on each side of the cheek-plate, the two riveted together through the latter. The cheeks are joined together by a front and rear bottom transom and a front vertical transom of thick iron plate.

The carriage is supported on two front and one rear truck-wheels, the latter being on an eccentric axle, thrown in or out of gear by a handspike projecting to the rear. When the rear wheel is not bearing, the rear end of the carriage rests on wooden bolsters, made fast to the under side of the rear bottom transom. When the carriage is in battery, two bolsters under the front ends of the cheeks rest on a traverse-circle

raised slightly above the level of the platform. The shock of the discharge is thereby thrown on these bolsters, and not on the wheels and axle.

In rear of the front truck-wheels there are two shafts running across the carriage, and having journal-boxes in the cheeks; the first one carries a pinion inside of the right cheek-plate and has a crank on each end, outside of the cheeks; the other carries a windlass, with a cog-wheel on one end and an iron drum on the other, just inside of the cheeks. The teeth of the wheel engage in those of the pinion. The drum is enveloped by a band-brake, which can be tightened by means of a screw, or within narrow limits by a lever placed on the outside of the left cheek, and held in any desired position by a pin through the lever and cheek-plate.

A strong rope is made fast at its middle to the side of the vessel, or the parapet in front of the gun, and the two ends are wound around the windlass and made fast to it. A certain pressure is applied to the brake by means of the screw and lever for that purpose. When the gun is fired, the recoil of the carriage is overcome by the rope, the friction between the brake and the drum offering a certain resistance to the turning of the windlass and the unwinding of the rope. Carriages of this pattern are made in Dantzic, for the Prussian navy, by Mr. Wagenknecht, who also designed it.

Turret carriage. (Plate XVII.)

Owing to the confined limits within which guns must be worked in turrets generally, it is necessary that carriages intended to be used in them should fulfill two essential conditions: 1st, of checking the recoil of the gun within a very short space, so that the chassis need not be long; and, 2d, of allowing the gun to be fired through a wide field of fire with a very small embrasure or port-hole. To satisfy this last condition it is necessary that means should be provided to raise and lower the gun quickly, making it turn around an axis in the embrasure; to fill the first condition different means have been used.

The carriage adopted for use in turrets is the invention of Mr. Wagenknecht, a manufacturer of Dantzic, and is known as the Minimal-schaeten-Laffete; that is, the minimum embrasure carriage. The chase of the gun rests on a strong swing-bed, *b*, of forged iron, which has a joint at the head *c*, and a strong bolt fixed in the sole of the embrasure. When the gun is raised or lowered the trunnions slide on the swing-bed, which turns around the point *c*. The cheeks *f* of the carriage of cast iron project out at top, and rest on the head of the piston *h* of the hydraulic press *g*. Below they are fastened to arms *e*, which are hinged to a lower arm, *d*, made fast to the body of the press. The pipes *i i* communicate from the steam-engine to the press, which is operated by a pump not shown in the drawing in order not to complicate it too much. That the gun may be manœuvered without being obliged to make use of the steam-engine, the carriage has a second apparatus for raising the gun, composed of a steel screw, *k*, which is turned by means of a ratchet and lever, *l*. The cheeks of the carriage carrying the gun can be raised or lowered either by the hydraulic press or the screws *k*.

The top carriage is mounted on two truck-wheels *m*, which have their axles in the lower arm *d*, and roll on the chassis-rails *n*, inclined upward to the rear. The cheeks and arms are connected together by bolts and the axles just mentioned.

The apparatus for checking the recoil is arranged symmetrically on

the right and left of the piece. A strong steel screw, *o*, with a square thread and long pitch, passes through a female screw, *p*, which forms a part of the cheek of the carriage. The front end of the screw *o* is terminated by a cylindrical shaft which carries the friction-brake. It is composed of the frustum of an iron cone, *q*, fitting into a conical drum, *r*, also of iron, the periphery of which is encompassed by a friction-band, *s*, of steel, which is pressed against it. (See Fig. 2.) The frustum *q* is securely fastened to the end of the screw. The drum *r* can turn on the strong hollow cylinder *t*, through which the cylindrical part of the screw passes, and is bolted to the swing-bed *b*. To make the adherence of the friction-cones more perfect, wedges of lignum vitæ are placed between their surfaces. The friction-band *s* of steel does not make an entire circle, but one end is fastened to the swing-bed, and the other to a metallic connection joining the two friction-bands together. (See Fig. 3.) A screw, *v*, tightens the bands more or less, and thus regulates the friction-brake.

In firing, the brake operates in the following manner: The gun recoils, taking along with it the whole hoisting arrangement. In the first instant the screw moves slightly to the rear, which causes the two friction-cones to press firmly against each other; but this motion to the rear is stopped almost immediately by the cylinder *t*, which is bolted to the swing-bed *b*. The screw pulled to the rear by the recoil of the gun causes the screw *o* and the frustum *q* to turn and communicate its motion to the drum *r*; but this is checked by the action of the friction-band, which must be regulated according to circumstances.

The gun and carriage are brought to a state of rest when the work of the friction thus produced and that of the ascent of the gun and carriage up the inclined chassis-rail *n* are equal to one-half the living force of the recoil. The piece then runs back into battery of itself; but as this motion to the front may under certain circumstances cause violent shocks, a brake similar to that just described, but proportionately smaller, is attached to the screw just in the rear of the cylinder *t*. The friction-cones are placed in a contrary direction to those first mentioned.

A buffer, *u*, composed of several strong disks of India rubber, and fastened to the rear end of the screw *o*, serves to stop the gun, breaking the shock gradually in case the friction of the brake has not been well regulated.

The banded 10.23-inch gun weighs 48,500 pounds, and the turret-carriage 19,340 pounds. A snatch-block for facilitating the insertion of the projectile and charge in the gun is fastened to the breech. The weight of the projectile is 485 pounds, and of the charge 159 pounds.

Each turret is armed with two guns, placed alongside and exactly parallel to each other. They are placed in position in the turret by being hoisted over the sides before the roof is put on, which is removable at pleasure. The machines used to put them in place are moved by the steam-engine.

The port-holes are circular at the middle of the walls, and open outward in every direction. Both on the inside and outside they are elliptical in shape.

For pointing the guns the entire turret is moved by means of a steam-engine. On its roof a front and rear sight are so adjusted as to determine a line of sight exactly parallel to the axis of the gun. An opening made in the roof between the two pieces allows the gunner to direct this line of sight on the target by making signals previously agreed upon to the engineer to turn the turret as may be required.

The elevation is given by means of the elevating apparatus already

described; but as the rolling of the ship does not permit the use of the spirit-level, a graduated scale of degrees is provided at the side of the gun. Before firing, it is evidently necessary to wait for the precise moment when the platform of the pieces is horizontal; this instant is indicated to the gunner by the passage of a plumb-bob over a certain mark.

Pointing the gun from the top of the roof is attended with certain difficulties, so it has been proposed to bore a small hole through the walls of the turret between the two guns, thus forming a kind of observation-tube with micrometer lines in it, and determining a line of sight parallel to the axis of the guns. The operation of pointing will be in this way more accurate and less dangerous.

Guns as large as 10.23 inches have been mounted on this kind of carriage, and the trials to which they have been subjected have given favorable results.

Prussian gun-lift. (Plates XIX, XX.)

The gun-lift adopted for service in the Prussian army consists of two telescopic hydraulic jacks, each mounted on a solid base, and carrying suspended from the heads of the two upper jacks a wrought-iron cross-beam, with a double hook depending from the middle for attaching the load. The lower jacks are 8¾ inches in diameter, and the upper ones 6¾ inches, each having a lift of 3½ feet. They are operated by means of a crank on an axle, which rests in two bearings on the lower jack. A fly-wheel with a handle is attached to each end of the axle; they are used to transport the jack from place to place.

The cross-beam is built up of two rolled plates placed vertically, strengthened by angle-irons, and joined together by a top plate riveted to them. A cast-iron block is bolted between the plates at the middle of their length, and a link passes around it and carries the double hook. Length of cross-beam, 10 feet; weight, 1,430 pounds. Capacity of the lift, 62,000 pounds, raised 7 feet.

To set up the lift.—Great care must be taken to prepare the foundations for the jacks to set on, so that they shall not yield unequally when the weight is brought upon them, and cause the jacks to upset. If the ground be soft, the foundations may be made of timbers bolted together and resting on piles. The jacks are placed on the bases at the proper distance apart, (depending upon the length of the cross-beam, which is usually 10 feet.) The cross-beam is brought into position by 24 men, the ends at the foot of the jacks. A chain is passed through the stirrup of the upper jack, and is made fast to the end of the cross-beam, which is raised by pumping the jack, and is rested on a trestle prepared for the purpose. The jack is now lowered, the end of the beam is secured in the stirrup, and the trestle removed. The same operation is performed with the other end, thus bringing the cross-beam into a horizontal position, and the heads of both jacks down.

The cross-beam is suspended more quickly and safely by using two trestles; raise both ends of the cross-beam at the same time, rest it on the trestles, lower the heads of the jacks, and suspend the cross-beam in the stirrups, then raise it slightly and remove the trestles.

To mount the gun.—The cross-beam is placed across the gun, a block of wood of proper shape being first interposed to protect the gun from injury. The first jack is placed 5 feet from the axis of the gun, and the end of the cross-beam is inserted in the stirrup. The second jack is set up in a corresponding position on the other side of the gun; a chain is passed through the stirrup and made fast to the end of the cross-beam

which is raised by pumping the jack; a trestle is placed under the cross-beam when it is brought to a horizontal position, the head of the jack is lowered, and the stirrup is placed over the end of the cross-beam. The slings are passed around the gun and hooked to the double hook. By pumping up the jacks the weight is raised.

When the gun-lift cannot be set up over the weight to be raised, it may be set up on planks, either in front or rear, and then moved into the required position by means of rollers. The lift is taken down in the inverse manner of setting it up.

To transport the lift.—Twenty-four men carry the cross-beam by two long handspikes run through holes in the beam for that purpose, and place it on a truck or cart. The fly-wheels are used as truck-wheels for transporting the jacks. The keys which fasten them to the axles are removed, also the handles. The heads of the jacks are secured by ropes, and the bolts of the axle-bearings tightened. The jack is brought down into a nearly horizontal position, and the stirrup is placed over the pintle-hook of a field-limber and secured by a rope.

Krupp's gun-lift. (Plate XXI.)

It consists of two quadrangular pyramidal pillars 23 feet high, made of angle-iron riveted together and strongly braced, as shown in Plate XXI, resting each on a solid base of cast iron. The pillars are connected at top by a cross-beam 19½ feet long, made of two principal trussed beams strongly secured by cross-ties, and carrying at the middle a double pulley, and at about 4 feet distant, on either side, a single pulley. A long chain is secured at its ends to the windlasses, *g*, passing over the pulleys and around the triple block, which is provided with a double hook to receive the ends of the sling-chains. The alphabetical order of the letters indicates the manner in which the wheels and pinions actuate each other. The chain thus makes a half turn on each single pulley, one turn on the double pulley, *g*, and one and a half turns on the triple block, as shown in the drawing, the ends of the chain being double between the pulley and block. It is easy to see how a limited number of men, operating on the cranks of the windlasses on both sides, are able to raise as heavy a weight as a 12 or 14 inch gun.

ENGLISH.

These carriages are made principally at the Royal Carriage Department, Woolwich, but some are built from time to time by contract, by outside parties. Several different kinds of carriages are constructed to meet the varied wants of service in forts erected at so widely remote periods of time, but the differences are rather in details than in principle, and a general description covering the whole, with a brief notice of some of the principal variations, will suffice to give a clear idea of their main characteristics.

Top carriage.

The top carriage is composed of two cheeks connected together by a vertical and a bottom transom, the attachment of the latter being strengthened by two knee-stays. Each cheek is made of a wrought-iron frame from 3½ to 4 inches thick, forged to the required shape, and planed on both sides. The plates, from .375 inch to .75 inch thick, and corresponding in general form to the frame, project beyond, both in in front and rear, thus forming recesses for the truck-wheels, and are

riveted to the frame, an inside brace being inserted between the plates where the vertical transom comes against them. The top and bottom surfaces of the cheeks are planed, the top being horizontal and the ends vertical when the carriage is on its chassis.

A metal trunnion-bed is made fast in each trunnion-hole by countersunk screws, and cap-squares are held in place by two feather-keys, which are attached to the cheeks by short chains.

The bottom transom is a plate from .875 to 1 inch thick, is secured to the bottom of the cheeks by screws with countersunk heads, and is planed where it comes in contact with the cheeks and rails, that it may have even bearing-surfaces.

Guides of angle-iron are riveted to the lower side, to keep the carriage straight on the chassis.

The vertical transom is a plate of .625 inch thickness, riveted along the lower edge and sides to an angle-iron frame, which is bolted to the cheeks and bottom transom. The upper edge is cut out in a curve, to allow the gun to turn on its trunnions freely without striking it.

The knee-stays are riveted to the bottom transom, near its rear edge, and are bolted to the cheeks, one to each cheek.

The truck-wheels are between the plates of the cheek. The front wheels have axles from 2 to 2½ inches in diameter, and rest in gun-metal bearings secured to the cheek by two screws, which act as feathers in slots in the head of the axle, and prevent it from turning round in its bearing. The axle is put in from the outer side, and keyed in place. The axles of the rear wheels are eccentric, and are secured in the cheeks by what are called drop-plates. By taking out the rear bolt of the drop-plate, and turning it upward around the front bolt as a pivot, the axle is freed. The axles are joined by a "connecting bar," in which are two holes to take the end of an iron handspike, so that the bar may be turned and both truck-wheels may be thrown in or out of gear at the same time. The inner end of each axle is made hexagonal, to receive a handspike socket in case the connecting bar should be damaged. To prevent the rear wheels from coming into play when the carriage recoils, a stop is riveted on the inside of each cheek.

The elevating apparatus (Plate XXII) consists of two wrought-iron circular racks pivoted to the gun and passing between the two plates of each cheek. The teeth are cut on the rear and convex edge, and work in the teeth of a pinion fixed to a spindle fastened in the cheek. On the concave edge a groove is cut, in which a friction-roller runs and keeps it engaged in the teeth of the pinion, and also prevents it from moving sideways. The axles of the pinion and friction-roller pass through gun-metal bearings in the cheek; that of the latter is secured by a nut, and the former has upon it a capstan-head and clamp-screw for holding the gun in any desired position. The capstan-head has holes in the periphery for the end of an iron lever by which it is turned. By turning this head the gun is elevated or depressed, for the head has feathers which enter slots in the spindle, so that any motion to the head is communicated to the spindle, and by the spindle to the pinion and rack. The clamp-screw binds the pinion, and prevents it from moving.

The thread of the spindle in the right cheek is left-handed, so that the gun is held clamped by turning the clamping lever to the rear. For the 10-inch and larger carriages, and for the 9-inch of future construction, the gearing of the elevating apparatus is somewhat different. The pinion which engages the teeth of the rack is driven by a worm and wheel, with one or two intermediate pinions. The worm and wheel are

placed on the inside of the cheek and held in place by two journal-boxes and caps bolted to the side of the cheek. To the rear journal-box a hinged clutch is screwed by a steel pin, and kept in place by a swivel-key. To throw the worm out of gear with the worm-wheel, open the clutch, turn the worm-shaft and draw it to the rear until the collar on it is in rear of the clutch; replace the clutch and the shaft is held with the worm out of gear. On carriages of the most recent manufacture the worm-shaft is inclined upward to the rear. The hand-wheel for turning this shaft is in all carriages just in rear of the end of the cheek.

A front and rear eye-bolt for tackle is bolted to each cheek and a buffer-block of elm is bolted to the front transom. A loop for the priming-wire is attached to the right cheek.

The hydraulic buffer. (Plate XXII.)

The recoil of the gun is controlled in all carriages for the land service by the hydraulic buffer. It consists of a wrought-iron lap-welded cylinder, with cast-iron cover-cap and flange, and wrought-iron piston-head and rod, a packing-gland and emptying-cock of brass. The cylinder is 77.375 inches long in the clear, and 8.07 inches in diameter, and holds 12 gallons 5 pints. The cap closes the rear end, being screwed on. The flange is screwed on the front end, and the cover is bolted to the flange. Both the flange and cover are flat on top, to allow the top carriage to pass over them without striking. To secure perfectly tight joints, a mineral composition is spread over the screw-threads of the cylinder before the cap and flange are put on, and the same, mixed with chopped hemp, is laid between the flange and cover before they are bolted together. The packing used to make a tight joint around the piston-rod consists of a piece of tow about 1.25 inches in circumference and 3 feet 7 inches long, greased with tallow, and wound round the rod and pushed into the recess in the cover. It is held in place by the packing-gland, which is made to squeeze the packing by being screwed into the cover until the rod can be just moved by the strength of one man. A zinc-pan is suspended from the front end of the cylinder to catch any oil that may drip from the gland in firing.

A filling-hole is bored and tapped in the upper surface of the cylinder near the rear end, and is closed by a wrought-iron screw-plug, which is secured to the chassis by a short chain. An emptying-cock of brass is provided in the lower part of the cover. The piston-head, 8.04 inches in diameter, has four holes drilled in it, each 1.25 inches diameter, for the 7-inch gun; .9 inch for the 9, 11, and 12 inch, and .8 for the 10-inch, and .7 for the 12-inch of 25 tons. The piston-rod screws into the head, and is prevented from turning by a screw. The collar-nut screws on to the rod a few inches from the end, and the connecting nut on the extreme end. The cross-head is held between the two nuts, with a play of about one-tenth of an inch, and the hole in the cross-head for the piston-rod is made oval, to allow of the top carriage being thrown on its truck-wheels without bending the piston-rod. The cylinder is secured to the chassis by means of iron bands which pass over the cylinder, and are bolted down to the rear bottom plate at the rear end, and at the front end to a bearing-plate which is bolted to the diagonal braces.

The rear bottom plate and the lower flange of the rear transom are hollowed out to form a bed for the end of the cylinder. The top flange of the rear transom is cut away from the cap of the cylinder. The cylinder, before being bolted down on the chassis, is brought to bear squarely against the rear transom, with the flat edges of the flange and

cap horizontal. Pieces of leather packing are placed between the cylinder and the iron bands which secure it to the chassis, and they are bolted down. It is proposed to insert a small screw through the front, bored a short distance into the cylinder, to prevent it from turning in the bands. Rangoon oil is preferred for filling the cylinder for use, and twelve gallons is the proper quantity to put in. The depth of the oil at the filling-hole is 4.625 inches, the gun being in battery.

The recoil of the top carriage at the discharge of the gun is checked by the resistance offered to the motion of the piston (the piston-rod being made fast to the top carriage) by the oil in the cylinder. The holes in the piston-head allow the oil to escape through them; therefore this resistance to motion will be proportioned inversely to the size of the holes and the quantity of air in the cylinder to be compressed.

The carriage for the 7-inch gun, under the conditions above named, with a battery-charge has a recoil of about 5½ feet, a little less than the extreme limit of the chassis. It is not generally necessary to reduce the quantity of oil for the service-charge, but if there should not be sufficient room to allow of the gun being conveniently loaded a little oil is permitted to run out until the proper recoil is reached.

The air in the cylinder, being compressible, acts as a cushion to the shock of the discharge of the gun, and reduces its violence. The proper quantity of oil to be used, with the depth at the filling-hole, is plainly marked on each cylinder.

The chassis.

The chasses vary in height according to the use for which they are intended, whether in casemates or open batteries. The former have an imaginary pivot in front, the chassis being prevented from recoiling and guided in its motion by the traverse-wheels, which have in their periphery a deep groove for the traverse-circle to fit into. The chasses for open batteries are divided into three classes: the first has the pintle in front, and, like the casemate, it is imaginary; the second, the pintle is in the center, and the third has the pintle in rear of the center. The height of the chassis at the front end is 32.5 inches, and others 37 inches. When increased height is to be given, it is done by putting in a knee-stay bolster, as seen in Plate XXV.

For the 7 and 9 inch gun the chassis-rails are rolled each in one beam 10 inches deep and 5½ in width of flange, bent round in front, and planed on the upper and lower surfaces and sides of the flanges. The front transom is a plate 1 inch thick, riveted along the sides and top to a frame of angle-iron. It is let slightly into the rails. A top plate is riveted to the front end of the chassis, and has an oblong hole in its length to give access to nuts below it.

The rear transom is a 7-inch beam, the flanges being 4 inches. It is fastened to the rails by a knee-plate bolted to it and the web of the rail. The traverse-forks are of wrought iron, with a flange or knee to strengthen it to resist the thrust of the recoil.

The front forks are secured to a truck-plate 1 inch thick, bolted to the chassis-rails. The rear forks are riveted to a connecting-plate, which is fastened to the truck-plate, and these are bolted to the rails, wrought-iron bolsters being used to give the slope of 4°. A front bottom plate, .875 inch thick, joins the rails near their middle, and a rear bottom plate is bolted to the under side of the rear ends of the rails and the rear transom.

A diagonal brace of 1-inch plate, with a center piece and four arms like the letter X, is bolted to the under side of the chassis, and its

center to the front bottom plate. The bent ends of the rails where they come together in front are joined by a connecting-plate which is bolted to the web of the two rails.

The traverse-wheels are of wrought iron, with brass bushings. They are cylindrical, with a deep groove turned in the face to fit over the traverse-circle. The rear traverse-wheels have only one flange, that on the front side. The journals of the traverse-wheels are steel, and are secured by a nut on the inner side. India-rubber hurters and counter-hurters are provided. Eye-bolts for tackle are bolted on each rail, one in front and one in rear; and a fifth is placed in the middle of the rear edge of the bottom plate, for use in transporting the chassis. Axle-tree bands to receive an axle for transporting the chassis are riveted to the front bottom plate.

The 9-inch chassis is provided with gear for (Plate 23) traversing and running the gun from battery, the same arrangement serving for either purpose by disconnecting by a shipper the parts not required. The gear is worked by crank-handles on either side of the rear end of the chassis.

A brass bevel wheel is screwed fast to each of the rear traverse-wheels. An inclined shaft, with a capstan and spur-wheel on the rear and a bevel wheel on the front end, extends from the rear end of the chassis down to two horizontal shafts running across the chassis just in rear of the traverse-wheels. These two shafts have a bevel wheel on each end; one engages with this inclined shaft, and the other with the brass wheel attached to the traverse-wheels. Motion is given to the inclined shaft by means of two crank-handles on a shaft running across the rear end of the chassis with a bevel pinion on it, and is communicated by the horizontal shafts to the traverse-wheels.

The inclined shaft can be thrown out of gear with the shafts communicating with the traverse-wheels. If then the fall be made fast to the top carriage, and passed around the capstan, the top carriage may be run back from battery by turning the crank-handles.

In center-pintle carriages, in which the front and rear traverse-wheels are of the same size, the chassis is traversed by communicating motion to one front and one rear wheel. This is done by means of a long shaft running under the left side of the chassis, and having pinions on it to engage in the wheels made fast to the traverse-wheels. Motion is given to this long shaft by means of a short inclined shaft, as already described.

In chasses having the pintle nearer the rear end, the front wheels, being the larger, are chosen as those to which motion is to be communicated. This is done by a long shaft running under the chassis. It is driven, as already mentioned, except in this case the cross-shaft is placed under the chassis-rails, instead of in rear of the rear transom.

The rails of the 10-inch chassis (Plate XXIV) are built beams, fish-bellied in shape, in order to get the required strength with the least amount of material. Two plates $\frac{3}{4}$ inch thick, cut to the required shape, are riveted to two T-pieces $6\frac{3}{4}$ inches wide. The webs come together at their front ends, but have an inner brace between them at the rear ends. The upper T is straight; the under one is bent to correspond to the plates. The depth at the front is $6\frac{1}{2}$ inches, $11\frac{1}{2}$ at the rear, and 18 inches in the middle. The 10-inch chassis, increased in height, (Plate XXV,) is the same, except wrought-iron knee-bolsters are put in to give the required height. The rails of the 11-inch chassis (Plate XXIV) have a depth of 18 inches in the middle, and a width of $6\frac{3}{4}$ inches.

The 35-ton gun-carriage differs from the preceding in some of the details. The cheek-plates are about .75 inch thick. The cheeks are joined together by a bottom transom of boiler-plate extending the entire length

of the carriage, and two vertical transoms, each strengthened by angle-iron riveted to it around the sides and bottom. The elevating apparatus is worked by a wheel outside of the cheeks.

The truck-wheels of the top carriage are thrown in gear by means of a hydraulic jack, which acts on a crank on the eccentric axle.

The front transom of the chassis is made fish-bellied, with the view of getting as much room as possible in rear of it for the piston, and the hurters, five in number, made of India rubber, are made fast to it. The counter-hurters are placed on the inside of the rail. The piston is placed as far to the front as possible. The cylinder for the hydraulic buffer is a wrought-iron lap-welded $\frac{3}{4}$-inch tube, about .31 inch thick when bored out. The holes in the piston-head are .6 inch in diameter. The recoil usually varies less than 2 inches in length, and only 4 inches when the extreme charges are used.

Thirty-five-ton hydraulic carriage. (Plates XXVII, XXVIII.)

This carriage was constructed at Woolwich, under the direction of Colonel Field, commanding the carriage department.

The hydraulic apparatus with which it is provided is used to check the recoil in firing, run the gun into battery or from battery, and also to traverse the carriage to the right or left.

These different operations are performed by means of two hydraulic cylinders, O and D, and the double-action pump F in the reservoir E, which contains a mixture of alcohol and water. The pump F, worked by means of the brake G, drives the liquid into the distributing-chest H, which sends it through the tubes I K L either to the front end of the cylinder O or to one or other end of the cylinder D. The desired position of the valve is given by means of the lever M attached to the right side of the chassis.

The cylinder D has a piston, the rod of which is fastened to the chain *c c*, which engages the wheel B. This wheel is mounted on the same axle as the pinion that drives the bevel wheels A intended to give motion to the rear traverse-wheels. Fig. 2 shows how the motion of the piston in either direction carries the chain *c* with it, thus causing the pinion to turn, and by its means the traverse-wheels.

To traverse the carriage to the right or left it is sufficient to turn the distributing-valve so as to send the liquid on one or the other face of the piston, and then to work the pump by means of the brake G. The chain moves on the wheel B with a velocity four times greater than that of the piston; a slight motion, therefore, of the latter is sufficient to traverse the chassis through a considerable arc.

A piston is also fitted to the cylinder D, which is used to check the recoil in firing, and to run the gun into battery. The piston has a leather packing on either face, and the front end of the rod P is fastened to the carriage. The front end of the cylinder is placed in communication with the distributing-chest by the pipe I, and the rear end by the passage R with a second reservoir, Q. The passage R can be contracted more or less by a conical valve S, which is regulated by means of the regulator I, fig. 3. To use the apparatus as a hydraulic buffer, close the communication of the front part of the cylinder O with the pump F through the distributing-valve H, and regulate the position of the valve S so as to reduce the section of the orifice for the stream according as circumstances may require. When the gun is fired, the carriage as it recoils forces the piston in, and drives the liquid into the reservoir Q through the opening around the conical valve; the recoil is checked as in the

ordinary hydraulic buffer, by the resistance that the liquid meets with in passing through the narrow orifice. The entire distance through which the valve may be moved is one inch, and the part of the valve-stem that projects is graduated into tenths of an inch. In firing with maximum charges the valve-stem is turned in up to the division of eight-tenths.

To run the gun from battery without firing, it is sufficient to open the communication of the pipe I with the pump F, and to work the latter. The pressure of the liquid on the front face of the piston forces it into the cylinder O and draws the carriage, being attached to the rod P, back with it. The liquid which is in rear of the piston escapes as before, but without meeting any resistance in its passage around the conical valve on account of the slowness of the motion.

To run the gun into battery, the front of the cylinder O and the tube T are placed in communication with the discharge-pipe by means of the distributing-valve H. The carriage then runs into battery of itself by reason of the inclination of the rails of the chassis. Its velocity is checked by the resistance that the liquid meets with in passing through the tube T. If it be wished that the gun shall run into battery more quickly, a special tube *c* is provided, of larger cross-section, which allows the water to pass more quickly; it will be sufficient to open the valve by means of the handle *b*, (Figs. 2 and 5,) to reduce the time of running in to a few seconds. By turning this handle the motion of the carriage may be regulated at pleasure, and it may be even stopped at any point on the chassis by closing the valve altogether.

The distributing-chest and its various connections are shown in Fig. 4. N is the discharge-pipe which conducts the liquid to the reservoir. The ordinary position of the valves is that represented in the drawing, the apparatus being arranged for running the gun from battery. The liquid forced by the pumps passes into the tube T, while K and L communicate with the discharge-pipe. If the valve be moved farther to the right, L remains in connection with the discharge-pipe N. T is closed while one of the orifices of admission comes opposite the outlet K. If, on the contrary, it is pushed to the left, I and K communicate with the discharge-pipe, and L with the other opening. These two extreme positions of the valve correspond with the traversing of the chassis in one or other direction, and the last also to running the gun into battery automatically.

A direction-plate is attached to the chassis on the right side, giving the positions of the lever M corresponding to those of the valve for traversing the gun to the left, from battery, gun to the right and into battery. A similar plate, *d*, with the words "closed" and "into battery," show the position that should be given to the handle *b* so as to regulate the running of the gun into battery.

One man at the valve-lever and two men at the pumps are sufficient to execute all of the manœuvers, though it is preferable to have four men at the pumps. The time required to traverse the gun through an arc of 54° is two minutes, and the same for running the gun from battery 6½ feet.

The loading apparatus is decidedly novel, (Fig. 1.) It is composed essentially of a chain with the links constructed like the joint of a carpenter's rule, so that it can turn only in one direction, while it is as stiff as a solid rod in every other. The links of this chain are made as follows: The angles of the links on top are square, while those underneath are rounded; two adjoining links thus abut against each other when an effort is made to bend the chain outward, while it can be readily

bent in the opposite direction. It is guided in its motion by a kind of tube X, inclosed between two sheet-iron plates, W. The spur-wheel and pinion V and U supply the means of raising the tube X out of its bed, and raising the chain up to the bore of the gun. The tube X is held at a convenient height by the pawl Y. A rammer or sponge is fitted to the front end of the chain according as it is wished to load or sponge the piece, and by working the crank-handles the chain is forced down the bore as if it were a rigid staff. The trials with this arrangement have given satisfactory results.

A still more original mode of loading, based on the use of a pneumatic apparatus, has been applied to a 35-ton gun in the experimental casemate battery at Woolwich. This arrangement, which has the advantage of requiring only very little room, is represented in Fig. 1.

The cylinder A is of the same caliber and has the same grooves as the bore of the gun, and in it the projectile is placed. It is fitted to the mouth of the bore so that the joint shall be hermetically closed. A piston, D, forming the rammer, fits accurately in the cylinder A. It has a hole, E, in its axis, continued by several small channels, *e*, which communicate through the windage over the shot with the space in rear of it. A flexible tube, F, is fitted to the central passage E, and is connected with the air-pump G. This tube has a metallic wire helix within it to prevent it from collapsing by the pressure of the air without when the air is exhausted from within it. The operation of loading is conducted as follows: The projectile being placed in the cylinder A, it is raised by the pulley H to the height of the muzzle of the gun, to which it is firmly secured. The rammer D is introduced in the cylinder, and the pump G is operated. The air in rear of the projectile being rarefied, the pressure of the outside air forces the rammer down the bore until it comes in contact with the cartridge. To withdraw the piston, it is sufficient to let the air into the tube F.

The difficulty of keeping such delicate apparatus in perfect condition so as to make a close joint at the mouth of the bore seems a serious obstacle to carrying out practically this mode of loading.

Muzzle-pivoting.

The vertical field of fire of guns mounted in casemates is so much restricted by the embrasure that the want has long been felt of a carriage which will allow the gun to be used at high angles of elevation, and also at a depression, without a great enlargement of the embrasure. With the view of solving this problem, a new carriage for casemates has been constructed recently, by which the gun can be fired through an embrasure of the usual dimensions at 15° elevation and 7° depression. The principle adopted in its construction is to vary the height of the trunnion-beds instead of always preserving them in the same fixed positions as in the ordinary carriages. To effect this, each cheek of the carriage is cut with a wide vertical slot, in which plays up and down a rectangular block of iron bored with a hole to receive the trunnion of the gun. Under this block is placed a strong screw to support the weight of the gun. By means of a hydraulic jack placed under each trunnion-block the gun is raised or lowered to any desired height, and the motion is at once followed up by the two screws, to which the weight of the gun is at once transferred. Two minutes are required to raise the gun from the lowest to the highest position. In order to obtain the greatest elevation, it is of course necessary to lower the trunnion-blocks to the bottom of the slot, and for the greatest depression to raise them to their highest position.

Moncrieff's depressing garrison-carriage.

This carriage as now constructed is represented in Plate XXIX. It has been made to mount guns of 6.3-inch, 7-inch, and 9-inch calibers, the latter being as large as it is thought practicable to work on this kind of carriage. The cheeks are made like those of the heavy carriages, of two ½-inch plates riveted together, with wrought-iron frames 3½ inches wide between them. The cheeks are connected by two transoms of plate-iron.

The elevator is made in the same way as the cheeks. The chassis-rails are of girder-iron, 19¾ feet long, 6¾ inches wide on the flange, and 12 inches deep for the 9-inch gun. Six traverse-wheels are used.

The carriage has been tested at Shoeburyness by repeated firings, some of which with the 6.3-inch and 9-inch gun we witnessed. The smaller gun comes down to the loading position after firing more smoothly and with less shock than the larger gun, the charge for which was 50 pounds of powder and a projectile weighing 250 pounds.

The 6.3-inch gun is designed to fire over a parapet 9 feet 4 inches high, and the 9-inch gun over one 12½ feet high.

Vavasseur's gun-carriage. (Plate XXX.)

This carriage, which was exhibited at the exposition in Vienna, is unlike all others that have preceded it in several important particulars; and though designed and constructed particularly for use on board of ships, deserves to be here noticed for the originality displayed in its conception and the ingenuity with which the details have been carried out.

The top carriage.

The cheeks are made in the usual way, each of two cheek-plates riveted together, with an iron frame between them, and held together by the transoms, as seen in the drawings.

A casting, N, is made fast to the front bottom transom, and strikes against the rollers O on the chassis, when the top carriage recoils.

There are four truck-wheels, two in front and two in rear. The axle *l* on which the rear wheels turn is an eccentric one, and has a handspike-socket, M, fitted on each end. By placing a handspike in either of these sockets, and bringing it down into the position shown in the dotted lines *o*, the rear end of the carriage is raised, the weight is thrown on the four wheels, and the gun can be readily run forward or back on the chassis.

The shafts *b* and *e* have their journal-boxes in the cheeks, and form a part of the machinery for running the gun into and from battery. On the former shaft two spur-wheels, *a a*, are mounted, the teeth of which engage in the oval holes R R in two plates riveted to the inner side of the chassis-rails. These wheels have cast on their inner side a second wheel of less diameter, the teeth of which engage in those of the pinion *d* on the shaft *e;* this shaft has eccentric bearings, and has mounted on it, outside of the cheeks, spur-wheels *g g*, which engage in the pinion *h* mounted on a short axle, the end of which is made square to receive the crank-handle *i*.

The handspike-socket is connected at its upper end by a bar, *p*, to the arm *q* on the eccentric journals of the shaft *e*, so that by bringing down the handspike into the position *o*, by which operation the top carriage is thrown on the truck-wheels, the eccentrics *f f* are by the

same movement turned sufficiently to enable the pinion *d* to engage with the teeth of the wheel *c* cast on the side of the spur-wheel *a*. Now, by turning the crank-handles *i i*, the top carriage is moved up, or down, the chassis-rails. The motion of throwing the truck-wheels out of gear withdraws the pinions *d d* from engaging in the wheels *e e*, so that when the top carriage recoils the wheels *a a* turn, but do not communicate their motion to the shaft *e*.

The apparatus for giving the elevation to the gun consists of two straight steel racks attached at top to the gun by means of pins passing through pieces, which slide in V's on the heads of the racks, thus allowing for the motion of the pins, which describe arcs of circles around the trunnions. The body of the rack is turned a cylinder, and slides up and down in sockets formed in the cheeks of the carriage. The teeth are on the rear surface, and engage with those of the pinion *s*, which is turned by means of a lever placed in the holes *t t*. To clamp the rack in any desired position, there are through-bolts V, with nuts, provided with handles *u*, by the turning of which through an arc of 120° the cheek-plates *x x* are pressed together sufficiently to pinch the body of the rack and hold it firmly in any required position as long as may be desired.

The guide-hooks *y z* are fastened to the outside of the cheeks, front and rear, and pass under a projecting edge of the cap piece forming the top of the rail, there being just sufficient play allowed to permit the carriage to rise when thrown on the truck-wheels.

The chassis.

The rails are formed of boiler-plates riveted at top and bottom to cap pieces disposed as seen in the drawing of the rear-end view, and held together with the usual transoms.

The angle-pieces Q are riveted to the inside of the rails near the top; they have oval holes, R, punched in them at regular intervals throughout their length.

The trough L is attached by means of trunnions to the front transom, while the rear end rests on the rear transom M. It has bearings at each end for the screw H. Angle-pieces, K, are riveted to the sides near the top to serve as guides for the nut K.

The traverse-wheel forks are secured to the outer side of the rails, thereby giving greater stability to the chassis.

The chassis has an inclination of 1½°. It rests always on the front wheels, but the rear wheels are on eccentric axles, and are thrown in gear only when the chassis is to be traversed. When not in gear, the props *z* rest on the traverse-circle.

In order to throw both wheels in gear at the same time, the shaft V extending across the chassis is provided with a bevel segment, X^2, and a handspike socket on each end, Y^2. The eccentric axles have attached to their heads each a bevel segment, X^1, which engages with the bevel segments just mentioned. By placing a handspike in the socket Y^1 near the middle of the shaft, or in either of the sockets Y^2 on the bevel segments on the end of this shaft, and turning it through an angle of 60°, the eccentric axles are both turned at the same time, and the end of the chassis is raised and made to rest on the rear traverse-wheels instead of the prop *z*.

The arrangement for checking the recoil of the gun is peculiar to this carriage. It consists of a steel screw, H, square in cross-sections, 30 inches pitch, extending nearly the entire length of the chassis. The front end of the screw has securely fastened to it a short conic frustum, H^1,

having gun-metal bearing-surfaces sunk into its periphery. This frustum of a cone works in a wrought-iron drum, which is bored out to fit the cone, similar to a friction-clutch.

The drum is surrounded by a metal brake-strap, J, which is provided with a tightening screw, J^1, a pointer, and a scale graduated into ten parts, and numbered.

A cast-iron nut, K, 20 inches long, fits the screw. At each end of the nut glands are provided, packed with felt to prevent the oil used for lubricating the screw from running out. In the middle of the nut the thread is cut away, forming a recess capable of holding about a pint of oil.

When the screw gets rusty, as it will in standing exposed to the weather, it is only necessary to run the carriage along the length of the chassis before firing, when the felt-packing will wipe the screw, and the oil in this recess will lubricate it perfectly. On the top of the nut two rollers are placed, against which the casting N presses when the gun recoils. The nut is not in any way fastened to the carriage, in order to avoid the liability to bend the screw by any vertical movement of the top carriage caused by the springing of the chassis-rails. This movement would have no effect on the nut or screw, but only cause the rollers *o* to turn round. It is for this same reason that the screw is not fastened to the chassis-rails, but to the trough L supported at its ends.

The action of the compressor.

The tightening screw J^1 is turned through a given angle; the exact degree can only be determined by experiment. When the gun recoils, the top carriage presses against the nut K, and this brings the surface of the conic frustum H^1 in close contact with the inner surface of the drum I. As the nut K cannot move to the rear without turning the screw H, this last is forced to revolve on its axis, and with it the drum I. The pressure with which the brake-strap is pressed down on the drum by tightening the screw J^1 determines the friction between the drum and brake-strap, and consequently the recoil of the gun. After one or two shots fired, the exact amount of pressure will be determined, and when once adjusted for a given charge of powder and shot the compressor requires no further attention, but is self-acting, and always acts whenever the carriage recoils a half inch, no matter on what part of the chassis it may chance to be.

The act of running the gun into battery releases the drum from the conic frustum, and the screw turns freely.

If, in drilling, or for any reason, it be desired to run the gun from battery, it is necessary to prevent the conic frustum from coming in contact with the drum, and thus leave the screw free to turn. To do this a lever Q is fixed to the rear of the screw S, which bears against the shoulder S^1 on the large screw H. By giving a half turn to the lever Q the screw S presses against the shoulder S^1, and prevents the large screw H from moving to the rear; the surfaces of the drum and conic frustum cannot come in contact; and so long as this is the case the screw H is free to turn, and the carriage can be run from battery by turning the crank-handle I.

In order to stop the carriage at any point of the chassis, or control its motion at any time, as may be frequently necessary in running the gun into battery in a sea-way, a small brake, T, is fixed on the rear end of the screw, and worked by a handspike placed in the socket V. By the

arrangement the carriage may be stopped instantly at any point of the chassis, and held there.

From what has been here said, it will be seen that the compressor is readily adjusted to meet the varying wants of service under different circumstances, and when once arranged is perfectly automatic, and requires no further attention till some change is made in the conditions of its use; that the gun is run into battery without having to touch the compressor to throw it out of action, but if for drill or other purpose this latter be desired, it is readily effected by the half turn of the lever Q.

From the experiments made both in England and France to test this carriage, it seems to have worked in the most satisfactory manner, being both simple and easy in its management, the gun being at all times entirely under the easy control of the gunner.

Moncrief's 9-inch hydro-pneumatic ship-carriage. (Plate XXXI.)

This is a depression carriage in which the force of the recoil is utilized to compress a certain volume of air contained within a close vessel, and is afterward employed to raise the gun from under cover to the firing position.

The gun is supported on two strong lever supports. One end of each embraces the trunnion of the gun, and the other is keyed to a heavy shaft which turns in journals near the foundation-plate. This shaft has two strong cranks which operate pistons fitted to the two cylinders *c c*. A third lever support is hinged at one end to the breech of the gun, and the other to a support attached to the elevating-apparatus. The cylinders *c c* communicate by means of strong pipes with the air-vessels *b b b*, and the valve *d* is arranged to permit the water to pass from *c* to *b*, but does not allow it to return. A sufficient quantity of water is used to assure the valves being always immersed in it. The air in the vessels *b b b* is compressed by means of the air-pump until it is under sufficient pressure to raise the gun from the loading to the firing position. When the gun is fired, the recoil forces the pistons in the cylinders *c c*, and compresses the air in the vessels *b b b*, which hold it in store until required to raise the gun for the next fire. By turning the valve which allows the water to flow back from the vessels *b b b* to the cylinders, the water at once presses against the piston-heads, and forcing them back raises the gun to the firing position.

The carriage is the same in principle as the hydro-pneumatic siege-carriage described further on, and to which reference is made for further explanation.

It is understood that the Dutch ship Hydra was provided with carriages constructed on this principle, with certain modifications made in them.

RUSSIA.

The supplies of heavy carriages, both for the land and sea services, have been obtained from private contractors, principally English companies established in Russia. More recently some carriages have been constructed at the shops of Aboukoff.

The only ones that came under our notice were those mounted in the forts at Cronstadt, but as it was requested of us not to make public anything that we should see during our visit to this stronghold, all notice of the Russian heavy carriages must be omitted.

FRANCE.

Permission was obtained to visit the private workshops of Messrs. Chaparède & Cie., Faubourg de St. Denis, where there were being fabricated for the French government some heavy ship-carriages of a recent pattern, the largest being for a 10.75-inch gun. We were here informed that this same model of carriage was used for guns mounted in the sea-coast fortifications, and thus far none others had been provided for them.

Top carriage.

The top carriage is made in the usual way, with two plates of boiler-iron more than a half inch in thickness, riveted together with a thick iron frame between them. The trunnion-beds in the top of the cheeks are provided with cap squares like those for the field-carriage.

The cheeks are connected to each other by transoms, the front one being of cast iron, and very heavy. The others are of rolled iron plates, the bottom one being very wide and curved downward between the cheeks. It is stiffened by iron bars riveted to it, the front end being re-enforced by a 6-inch trough-beam curved to fit it.

The elevating apparatus consists of a bar-link chain passing underneath the breech of the gun, which has a preponderance, and made to wind on an axle made fast to each of the cheeks, and is turned by means of a rim-wheel on their outer face. By turning the wheels in one direction the chain is unwound from the axles, thereby made longer between the cheeks, the breech is lowered, and angle of elevation of the gun is increased. By turning the wheels in the opposite direction, the chain is drawn up, the breech raised, and the elevation of the gun diminished. The top carriage is provided with four truck-wheels for running the gun into battery. They are placed in the front and rear of the cheeks, between the plates. The rear ones are on eccentric axles, by which they can be thrown in gear at pleasure, and when thrown in the rear end of the carriage is raised more than an inch from the rail, and the whole weight is brought on the four truck-wheels.

The hand-spike sockets on the eccentric axles are made of wrought iron as a matter of economy instead of bronze. Two iron rings are made fast to the front face of the cheeks for the purpose of attaching the hooks of pulley-blocks, by which to haul the gun into battery if for any reason it fails to run in when the truck-wheels are thrown in gear; ordinarily this will be sufficient, giving the gun a start, and pushing it by hand.

The top carriage for casemate guns is sometimes made of wood, it being protected from the weather in the casemates; and for barbette carriages cast iron is sometimes used.

The brake.

To check the recoil a compressor or friction brake is applied. It is composed of several long flat iron bars placed on their edges between the rails of the chassis, and parallel to them, one-half of the number on the right and the other half on the left of the middle line between the rails. These bars are fastened at each end on a bolt, so that they can move freely within narrow limits to or from each other, but cannot move in the direction of their length. Between these flat bars there are interposed short plates, suspended by notches on the front and rear edges from transoms of the top carriage, just behind the front truck-wheels. These short plates are pressed forcibly together by means of a screw,

which runs from one cheek-plate to the other through bronze boxes secured in them. On the screw are two nuts, which bear against the short plates and are prevented from turning with the screw, so they must move in the direction of the length of the screw toward one or other end, depending upon the direction it is turned. The screw is prevented from moving lengthwise by means of a key at each end. The left end of the screw, where it projects through the cheek-plate, is cut into numerous teeth, like a cog-wheel, to receive a strong lever-handle, which can be thus put on in a great many different positions. By moving this handle to the front when the lever is below the screw the nuts are brought to bear on the short plates, and press them against the long friction-bars. By turning the handle in the opposite direction the pressure is relieved. A lug or stop is bolted to the side of the chassis-rail, and when the gun recoils, the handle, striking this lug, turns the screw, increases the compression on the friction-bars, and adds to the friction with which the carriage commenced to move back.

The action of the brake in checking the recoil is as follows: Before the gun is fired all of the force that a man can exert is brought against the handle of the screw to press the short plates against the friction-bars; the lever-handle is then taken off and put on in such position that in striking the lug on the chassis-rail as the top carriage recoils it shall be turned just enough to give the required pressure to regulate the recoil, not checking it too quickly, but stopping the carriage before reaching the end of the chassis. The exact position to place the handle in order to regulate the recoil at will can only be learned by firing a few experimental rounds.

When the gun is fired the top carriage moves back a short distance with a moderate friction, thus avoiding great strains on the carriage at the moment of discharge. After moving back about a foot the handle of the screw strikes against the lug on the rail, turns the screw, and increases the pressure on the friction-bars, and the friction, in proportion to the angle through which the screw is turned, checking the recoil according to the friction developed.

When the carriage is to be run in battery, the handle of the screw is turned to the rear, and the pressure on the friction-bars is released. The rear truck-wheels being thrown in gear, the top carriage will run into battery; if the motion be too rapid it can be checked by turning the screw, bringing into play sufficient friction to regulate at will the motion of the gun.

Chassis.

The chassis is composed of two solid rolled-iron beams, connected by front, rear, middle, and bottom transoms. In the smaller carriages for the 32 and 42 pounder guns the two rails are in one piece, bent in the arc of a circle in front. In the carriage for the 10.75-inch gun, the top of the rail is about 7 inches wide. It is about a foot deep, and the web is about an inch thick. The inclination of the chassis for sea-coast carriages is 4°. The pintle-transom is composed of three wide plates, laid one upon the other and firmly riveted together. The front transom is of cast iron, very heavy; the middle of it rises some distance above the top of the chassis, and is rounded for a belaying-post, the breeching passing around it to check the recoil in case the brake should be disabled or get out of order. A spring-buffer is made fast to the rear side, against which the top carriage strikes when running into battery too quickly.

The bottom transom covers the rear part of the chassis and forms a flooring for the gunners to stand on.

Between the rails and parallel to them are sixteen friction-bars about $\frac{5}{8}$ inch thick, placed on edge, and between the middle line of the chassis and the rail, eight in each group. They are fastened at each end to the chassis by two bolts, as already described.

On the inside of the rails, near the rear end, the counter-hurters are placed. They are made of India rubber, with a wooden face for the top carriage to strike against.

The traverse-wheels, instead of being under the chassis as is usual, are very low and placed on the outside of the rails, the curved traverse-forks being bolted to the outside of the rails. This gives greater stability to the carriage, which for a ship's carriage is a matter of importance.

Concentric with the rear traverse-circle, and a little below its level, there is a second circle made of bronze, with recesses cut in it to engage the teeth of a large wheel, by means of which the lateral traverse of the carriage is given. In the rear of the chassis the crank is placed which operates this wheel through a system of wheels and pinions, so that two men can traverse the gun with ease.

The carriage is a very heavy and expensive one, weighing from 18 to 20 tons, and costing $10,000.

SWEDISH. (Plate XXXII.)

The cheeks of the top carriage, instead of being formed of two plates of boiler-iron riveted together with an iron frame between them, as usual, are made each of a single plate of iron $1\frac{1}{2}$ inches thick, cut to the required shape. The journals for the truck-wheels are formed by boring holes in the cheek-plates at the proper places, and re-enforcing them by circular iron plates 1 inch thick, fastened to the cheek-plate by four bolts each. The transom, which is usually vertical, has in this carriage an inclination of 45° with the vertical, sloping down from the trunnion-beds to the rear.

The elevating apparatus, placed on each side of the carriage, consists of a worm on the outside of the cheeks, operating a wheel and pinion, the latter playing in a rack attached to the breech of the gun.

The rails are built beams, the web being a plain flat plate 1 inch in thickness, to which is riveted on either side at top and bottom a piece of angle-iron, forming a double T-rail, which is further strengthened by riveting to the angle-irons a flat bar on top and bottom.

The recoil is checked by a hydraulic buffer, constructed after the English pattern. The gun being a breech-loader, the carriage is so constructed that the gun shall be returned by the force of the recoil into the position in battery, in the same way as has been described in speaking of the German carriages. The traverse-wheels are like those used generally in Europe.

The carriage is traversed by means of a crank at the rear end of the chassis, operating an endless screw and wheel, which turns the traverse-wheels.

SIEGE-CARRIAGES.

The greatly improved facilities of late years for transporting heavy guns by railways, steamers, &c., have rendered it practicable to use for siege purposes guns which would have been regarded a few years ago as entirely beyond the range of possibility for such uses. At that time, a gun throwing a 30-pound projectile was the largest siege-gun to be

found in any service, while now it would be difficult to fix a limit to the size of the guns that may be used against besieged places. The gun-carriage must of necessity conform to the gun for which it is constructed, and we see now constructed for siege purposes carriages which differ in no material point from those made for garrison and sea-coast defense, so less clearly have the distinctions between the different classes of guns been defined.

AUSTRIAN. (Plate XXXIII.)

With the view of affording greater protection to the gunners serving siege guns, a modification has recently been made in the siege-carriage. This change consists in raising the gun about a foot and a half higher above the ground than in the old carriage.

No new constructions have been made, but, to gain the proposed advantages of this new improvement at the least expense, it was determined to alter the old carriages on hand by adding to the height of the cheeks. This has been done by making a strong forged-iron frame, which fits closely in the trunnion-bed of the old carriage, and has a trunnion-bed in its upper face. This iron frame is firmly bolted to the top of the cheeks of the old carriage, leaving it in other respects unchanged. The frame is made in two parts, held firmly together by a bolt.

The elevating apparatus, instead of having a stationary female screw, has one attached to a movable elevating-quoin of wood resting between the cheeks, to which its front end is hinged by the bolt *b* passing through the cheeks, so as to turn freely around it. The rear end of this quoin is held by another cross-bolt running through the two iron uprights *c* on the outside of the cheeks. There are three holes for this bolt in the cheeks and iron plates, so that the position of the quoin may be shifted according to the elevation desired, affording a ready means of giving very different degrees of elevation to the gun, at the same time using only a short elevating-screw, by raising or lowering the seat of the female screw. Two separate female screws are attached to the elevating-quoin, so as to accommodate guns of different lengths, which may be mounted in turn on the same carriage, thus having only one carriage for the siege-gun and rifled howitzer.

An iron step, M, for the gunner is placed above the middle transom, and when not in use can be turned over in the position M^1.

This style of carriage is used for the 12-centimeter and 15-centimeter siege-guns and 12-centimeter howitzer. The axis of the piece is 62 inches above the ground. The carriage will admit of an elevation of 34° and depression of 17°. It weighs 3,540 pounds for the 15-centimeter (6-inch) gun, and 2,850 pounds for the 12-centimeter (4¾-inch) gun. A wheel weighs 320 pounds. The width of track is 48.4 inches.

Height of the trunnions	72 inches.
Weight of the carriage with wheels	2,750 pounds.
Width of track	65 inches.

GERMANY. (Plate XXXIV.)

This carriage resembles much in its general appearance that just described. It is a wooden carriage of old pattern, well ironed with a strong wrought-iron frame firmly keyed and bolted to the cheeks, to support the gun, raising it high above the platform. The cap-squares are made with projections which fit over lugs on the trunnion-beds, and are kept in place by an eye-pin.

The elevating apparatus consists of a long screw with a wheel-handle, working in a female screw with long arms terminating in trunnions which fit in beds on the top of the trail. The lower end of the screw turns in a collar secured to an upright on which the breech of the gun rests. The head of the upright is supported by two rods which turn on a cross-bolt just under the trunnions, and its foot by rods which are hinged to the first supporting-rods. The screw has an inclined position, and rises when the gun is depressed in rear of the breech. The gun may be elevated 31° and depressed 10°.

The axle is of iron, and is supported at the shoulders by two strong supports which connect it with the trail. Steps are provided, one between the sides of the trail for the gunner to stand on while pointing, and one on the side to enable him to mount on the carriage.

Krupp's. (Plates XXXV, XXXVI.)

The siege carriage for the 21-centimeter (8.26-inch) gun is made of wrought iron, and consists of a top carriage and chassis, with a hydraulic buffer to check the recoil.

The top carriage is essentially the same as his carriage already described for sea-coast guns. The gun can be elevated from 6° depression to 26° elevation. The chassis differs in some minor particulars; it has an inclination of 4°; the rails are rolled each in a single piece; the front traverse-wheels are omitted; and the chassis has a bolster on the front transom, which rests on the pintle-plate, the pintle entering the bolster.

The crane and hydraulic buffer are similar to those used in the sea-coast carriages. The traverse-wheels have the face hollowed out so as to fit over the traverse-circle, (which is not flat but semicircular in cross-section,) and have holes in the face to receive the end of a truck-handspike to traverse the carriage. On the outer side of the rails, toward the front end, there is bolted to each rail a lifting apparatus, consisting of a screw worked by a wheel and worm, and an iron stirrup to receive a strong axle provided with a pair of large iron wheels, used in transporting the gun and carriage. The axle has a square body. The wheels have bronze felloes, shaped thus ⌙ and cast in sections; the spokes are iron rods.

To prepare the carriage for transportation the top carriage is run back nearly to the counter-hurters, the chassis is raised from off the pintle by means of the lifting apparatus, the transport-axle is secured in the axle-stirrup on top of the rails, and the transport-wheels are put on. These are 80 inches in diameter and have a 7 in. tread. The traverse-wheels are removed, and the rear end of the chassis is raised and secured to the limber. The traverse-wheels may be carried in another wagon to lighten the load of the gun and carriage.

The crane is removed and secured against the side of the carriage. A shoe is provided to lock the wheel in going down hill.

The platform is made of oak timbers bolted together. The cast-iron pintle-block and the traverse-circle are bolted to the platform. For transportation the platform is taken to pieces, and may be carried in an ordinary baggage-wagon.

To establish the gun in battery, the ground is first leveled and rammed until it be firm, the platform is laid and the pintle-block and traverse-circle are bolted down; the gun is brought over the platform, the front bolster over the pintle, and the chassis supported by the lifting apparatus; the transport-wheels and axle are removed, the trav-

erse-wheels are put in place; the limber is removed, and the chassis lowered in place.

	Pounds.
Weight of top carriage	2,033
Weight of chassis	3,810
Weight of the gun limbered up	18,000
Weight of platform complete	4,586

15-*centimeter carriage.* (Plate XXXVII.)

The 15-centimeter (6-inch) carriage is made of wrought iron, with the exception of the wheels, which are of wood, with bronze nave-boxes.

The cheeks, which are unusually high, the center of the trunnion-beds being 6 feet above the platform, are made of boiler-plate, strengthened with angle-irons riveted around the edge; the cheeks continued to the rear, parallel to each other, and joined by transoms, form the trail. The traveling trunnion-beds are placed on the trail, bringing the center of gravity of the gun, when it is on the road for transportation, as low as possible.

The elevating apparatus consists of a single screw with a rim-wheel handle, and a female screw with projecting arms terminating in trunnions which fit in journal-boxes in the sides of the trail. In order to obtain a great range of elevations without increasing inconveniently the length of the screw, two sets of journal-boxes are provided; one on the top, the other in the sides of the trail. The carriage admits of elevations up to 35° and depressions down to 5°, with a screw of moderate length.

The striking peculiarity of this carriage is the application of the hydraulic buffer for checking the recoil in carriages of this kind, by which means the recoil is controlled within the limits of about one yard.

The cylinder of the buffer is placed under the middle line of the carriage, between the cheeks, to which its rear end is fastened by a cross-head, at a distance from the rear end of the trail of about one-third its entire length, and may be raised or lowered within narrow limits. The piston-rod is fastened by a pivot-bolt to a timber anchored in the parapet, and can be moved vertically as well as horizontally to accommodate different positions of the carriage. An ordinary wagon-brake is provided to control the motion of the carriage down hill. It acts on the tread of the tire, and the pressure is applied by means of a screw attached to a cross-head on the front ends of the cheeks. Two iron brackets are fastened to the outside of each cheek, opposite the breech of the gun, for a step or platform for the gunners to stand on while loading the gun. The platform provided is the ordinary siege platform, laid down horizontally instead of sloping up to the rear end.

Weight of carriage, 4,068 pounds; height of wheels, 62 inches.

RUSSIAN.

This carriage is in most respects like the mortar-carriage hereinafter described, consisting of a top carriage mounted on a wooden chassis. The cheeks of the top carriage are made of a single thickness of boiler-plate about ½ inch thick for the 24-pounder gun, strengthenedby angle-iron riveted to it around its outer edge. The trunnion-plates are riveted to the cheeks. The transoms, six in number, are wrought-iron sleeves over the bolts which pass through the cheeks, and are held by nuts on the outside. The two rear bolts hold two iron stirrups, to which is attached a wooden block in which is placed the female screw

for giving the elevation of the gun. The axle, which is large, with a square body, is placed close to the front edge of the cheeks. This is put in all carriages, whether used in garrisons or for siege purposes, though of use only for the latter.

The wheels are made entirely of wrought iron. The spokes, eight in number, are cut from two wide bars about an inch in thickness, leaving the bars at their middle uncut. The two pieces are placed, the one on the other, at right angles to each other, and firmly riveted together; an additional piece is riveted on each side, and a hole is bored through the four thicknesses which constitute the nave. There are no proper felloes, but the tire is in two pieces, each a complete hoop, the one shrunk on over the other. The tenons of the spokes extend through only the inner thickness. Holes are drilled through the tire, at regular intervals, for truck-handspikes.

The chassis is composed of two wooden rails connected by transoms, just like that for the mortar-carriage, and rests on the platform without traverse-wheels or other mode of traversing than handspikes or snatch-blocks.

ENGLAND. (Plate XXXVIII.)

This carriage is constructed in the same manner as the field-carriage. The trail-plates have parts cut out so as to lighten them, and are riveted to the inner side of the angle-iron frame.

The elevating apparatus is composed of a circular rack attached to the breech of the gun, worked by a pinion on the inside of the right cheek, a friction-wheel holding the rack against the pinion, which is worked by an endless screw with a wheel-handle projecting above the top of the trail. The endless screw is inclosed in an iron box on the outside of the right cheek. The elevations that can be given are embraced between 35° elevation and 5° depression.

An iron box is provided in the trail to carry the circular rack when the gun is in the traveling trunnions. The lock shoe and chain are on the left of the carriage.

The limber is made entirely of iron.

	40-pounder.	64-pounder.
Weight of carriage	2,744 lbs.	3,416 lbs.
Weight of limber	1,246 "	1,246 "

Width of track, 62 inches.

Moncrieff's hydro-pneumatic. (Plates XXXIX, XL.)

Major Moncrieff urges with much force that by the adoption of a compressing carriage for siege-guns, embrasures for earthworks, which are entirely unsuited to modern warfare, may be dispensed with, and better and safer battery can be used; namely, that in which the guns are planted in pits or trenches where the gunners are entirely protected from the fire of sharpshooters and the direct fire of canister and shrapnel. In his siege-carriage, instead of using the recoil of the gun to raise a counterpoise weight which shall in turn elevate the gun from the loading to the firing position as in his sea-coast carriage, he utilizes the recoil to compress a volume of air, which being brought to act upon the gun shall raise it to the firing position. The same idea, was proposed several years ago by Mr. James Eads, civil engineer, of Saint Louis, and a carriage made to operate on this principle was patented by him.

Moncrieff's carriage is built for a 64-pounder rifled gun. It resembles in its general appearance an ordinary wrought-iron siege-carriage, and differs from it only in the addition of the hydro-pneumatic cylinder and piston, the elevating arms or supports, and a modification of the apparatus for pointing the gun.

Between the cheeks of the carriage is placed a cast-iron cylinder with trunnions, which are supported in trunnion-beds in the cheeks. The cylinder hangs in a vertical position, and comes down to within 15 inches of the ground. This cylinder is a compound one, having an inner cylinder in its axis, there being two channels of communication between them, closed by valves. The first is intended to permit the passage of the liquid from the inner to the outer cylinder, and is closed on one side by a valve which works automatically, and on the other by a regulating-valve for moderating the motion of the piece at the last part of the recoil, and also acting automatically; the other channel allows the liquid in the outer cylinder to pass into the inner one, and is closed by a valve which is operated by means of a lever attached to the left trunnion of the cylinder. A piston fits the inner cylinder closely. Its head is divided into two branches and serves as a transom to the two lever-arms, to which it is secured by hinge-bolts. The two lever-arms are strong wrought-iron bars, the lower ends of which are formed in the shape of trunnions, and fit in the trunnion-beds of the carriage, being held in place by the cap-squares. The upper ends have holes bored in them to receive the trunnions of the gun. In the firing position these arms are nearly vertical, and raise the axis of the piece 8 feet above the platform; the recoil brings them nearly horizontal, lowering the trunnions of the gun to about 3¼ feet. Two long iron rods are fastened at one end to the breech of the gun by a hinge-bolt, and the other end to the elevating apparatus.

The inner cylinder is filled with liquid, which also occupies the lower part of the outer cylinder, but only for a short distance, so as to cover the passages between the two cylinders. The liquid is a mixture of one part of glycerine to two of water. The air in the outer cylinder is compressed by means of an air-pump before it is put in position. The exact degree of pressure must be determined by experiment.

The carriage is held in place behind the epaulement by means of a chain or rope, which is made fast at one end to a hook on the axle at its middle point, and the other to an anchor in the ground in front of the gun. The recoil of the carriage must be prevented, in order that the hydraulic apparatus may be made to operate.

The regulating-valve of the cylinder is worked by a crank, which is moved by a connecting-rod attached at its upper end by a hinge-bolt to the right lever-arm. The connecting-rod has a slot in its lower end, in which the pin of the crank plays. Supposing the gun to be in the firing position, the regulating-valve is wide open. When the gun is discharged, the recoil presses the lever-arms down to the rear, forcing the piston in the cylinder, which turns around its trunnions. The pressure on the liquid opens the valve and allows it to pass into the outer cylinder, compressing the air contained therein. The regulating-valve is open during the greater part of the motion downward, the length of the slot being so regulated that the pin of the crank will not reach its upper end until the gun is almost down, when it will turn the crank and close the passage between the two cylinders. The trunnions strike on India-rubber buffers bolted to the upper side of the cheeks. The greatest distance that the piston can be forced into the cylinder is 28½ inches, and the dimensions of the cylinder and piston are such that at the end of

the motion this air will have been compressed to about one-third of its original volume.

When the piece is loaded, in order to bring it to the firing position, it is only necessary to open the passage between the outer and inner cylinders. To effect this, the gunner on the left turns the key in the left trunnion of the cylinder, and opens the valve which allows the liquid to return to the inner cylinder; the pressure of air drives back the liquid, which raises the piston and the gun. Two chains fastened on the right and left of the piece, one end to the lever-arms and the other to the cheeks, stop the gun when it has reached the firing position. During the upward motion the connecting-rod attached to the right lever turns the regulating-valve and opens it ready for the discharge of the piece. A windlass between the sides of the trail affords the means of bringing down the gun by the aid of ropes to the loading position without firing, or when the trunnions are not brought in contact with the rubber buffers, as will happen when firing with small charges at high angles.

The elevating apparatus consists of two circular racks placed on the inside of the cheeks, and operated by means of an endless screw, which turns a pinion engaging in the teeth of the rack. The two long iron rods attached to the breech are hinged to the upper end of the racks. By turning the handle of the endless screw, the circular racks are raised or lowered, and also the breech of the gun. The circular rack has its center at the point around which the rod is pivoted on the breech of the gun when it is in the loading position, so that the angle that its axis makes with the horizon in this position is the same, no matter at what angle it may be fired.

Reflecting sights are arranged on the carriage, so that the gun may be aimed by the gunner without exposing himself to the enemy's fire.

The carriage is mounted on an ordinary siege-platform, and the parapet should be an overhanging one, in order that there should be the necessary space for loading, and to insure the muzzle of the gun when in the firing position being well beyond the crest.

If the hydro-pneumatic arrangement be disabled, the gun may be then mounted on the carriage as an ordinary siege-gun.

The hydro-pneumatic cylinder should be charged in the park and not in the battery. Air-pumps are provided for this purpose. The mean pressure in the cylinder during the experiments has been 400 pounds per square inch, about 27.2 atmospheres, the piece being in the firing position, and corresponds to 500 pounds when it is in the loading position. If it should be necessary for any reason to increase the pressure in the cylinder, portable air-reservoirs are provided containing air compressed to 75 or 80 atmospheres. The gun has been fired many times with 12 pounds of powder and a projectile weighing 64 pounds; the carriage worked well. It has been found that it can be fired at the rate of one round per minute at low angles of elevation.

The weight of the carriage complete is 62¼ cwt., the service-carriage being 32¼ cwt. Major Moncrieff believes the weight may be reduced (by making the cylinder of bronze instead of iron, the plunger a hollow cylinder of wrought iron, and the lever-arms of built beams instead of solid) to 50¼ cwt.

The great weight of the carriage is still regarded as a serious objection to it. Besides, the complex and delicate nature of the machinery and the complication of stores required to go with it, induce the belief that it would prove too cumbrous for use in sieges generally.

MORTAR CARRIAGES.

The application of the principle of rifling to mortars, in common with guns of all kinds, has had the effect to obliterate to a great degree the sharply-defined lines of distinction which formerly divided the different classes of cannon, and to reduce them more closely to a common model, adapted more nearly to a common use. The rifled mortar, to give it the desired efficiency, has been increased in length until it differs in no respect from a howitzer or short gun, and is no longer confined as formerly to a vertical fire exclusively, but may be used with effect for direct or curved fire, with solid or hollow shot, as well as shell.

The carriages for the different guns have had to undergo necessarily corresponding changes to adapt them to the new conditions of service; and as the guns have been modified till they bear a close resemblance to each other, so the carriages on which they are mounted are less distinctive in appearance and more nearly approach the same pattern. The mortar, in place of being mounted as formerly on its bed, must in its changed condition be provided with a carriage constructed so as to enable it to deliver its fire at any angle from 0° to 60°, and be turned with promptness on any object within a wide field of fire.

AUSTRIAN. (Plate XLI.)

This carriage is composed of two cheeks, each formed of two plates of boiler-iron riveted together around their outer edges, with a wrought-iron frame between them. The cheeks are 47 inches high in front and 18½ inches in rear. Trunnion-beds formed in the upper face are provided with trunnion-plates and cap squares; the latter are held each by two keys.

The two cheeks are joined together front and rear by two transoms, each formed of two plates of iron and angle-irons. These transoms pass through cuts made in the inner plate and are riveted to the outer plate of the cheek; they are also secured to the inner plate by angle-irons riveted to each. Two bolts, *a* and *b*, pass through these transoms and join the cheeks, besides the bolt *c*, about a third of the height from the top in front. The part of the bolts embraced between the cheeks has a wrought-iron pipe over it.

A square hole, *d*, is cut in the cheek near the front edge, intended for the wrought-iron axle used in transportation. The axle is composed of a body, square in cross-section, and two cylindrical arms for the wooden wheels.

The cheeks are provided with four pairs of truck wheels, S, two for moving the carriage to the front or rear, and two others for moving it laterally. They are all mounted on eccentric axles, which have cast-iron handspike sockets, *t*. The carriage may be thus moved in either direction, as may be desired, or it may rest flat on the platform for firing. The axles are held in position by means of keys.

The elevating apparatus is composed of a screw, *h*, which moves the nut *f*; this has a hook which bears against the breech of the mortar. The screw rests in a bed of sheet-iron inclined upward to the rear, riveted by angle-irons to the inner face of the cheeks. Near the rear end of the bed there is a collar, *i*, in which the screw turns. The head of the screw has in it holes in which is inserted a crank-handle to give rotation to the screw. The nut is guided in its motion by two projections which move in corresponding grooves in the bed. For firing at low angles of eleva-

tion a block is placed on the hook, fitting over it and increasing its height.

In order to bring the mortar quickly from the firing position to that for loading, there are fastened to either side of the breech of the mortar two circular steel arcs with teeth which engage each with a pinion on the inner face of the cheeks. A wheel and pinion on the outside of the cheeks are used to give motion to the inner pinion.

A key, *r*, serves to hold the mortar in any desired position. The two circular arcs rest against bronze friction-wheels. These arcs are also used when it is desired to change quickly from one angle of elevation to another quite different. The breech is raised by the use of the pinions, but the nut is brought back by turning the screw with the hand until it is in a position near the desired one, when the exact angle is given by means of the crank applied to the head of the screw.

An arrangement is made for pointing the mortar quite similar to that used in Prussian siege-carriages for firing when the object cannot be seen. A sheet-iron plate, *v*, is hinged to each transom and habitually kept in a vertical position by a hook or turn-key, and let down on the platform when the mortar is to be pointed. The direction of the fire being determined, two strips of boards are screwed to the platform and divided in millimeters, one strip corresponding to the front pointing-plate and the other to the rear one. These plates have each an index marked on it, enabling the gunners to point the mortar in a direction parallel to the one desired. Before firing, the pointing-plate is raised and fastened.

A small shelf, *u*, is bolted to the oblique faces of the cheeks, and intended to support the breech wedge when it is taken from its mortise. A piece of board should be first laid on the shelf for the wedge to rest on.

In order to transport the mortar an axle is inserted in the cheeks of the carriage and ordinary wheels are put on, raising the carriage with jacks. A trail is provided which has a lunette for hooking on to an ordinary siege-limber; it is secured to the carriage by passing one end under the front transom and engaging it in two hooks under the pointing-bed, and held by a cross-piece.

Weight of the carriage, 5,140 pounds; of the axle, 231 pounds; the trail, 192 pounds; with the lock-chain and shoe, 286 pounds; the two wheels, 476 pounds; the limber with wheels, 838 pounds; the total weight of the carriage ready for traveling, 6,973 pounds; with the mortar, 17,826 pounds. Width of track of rear wheels, 72 inches; front wheels, 48.5. Angle for turning, 42°.

The elevating screw with the ordinary hook will give elevation of 20° to 60°; by putting on the block, angles from 10° to 20°.

GERMANY. (Plate XLII.)

This carriage is composed of two wooden cheeks, the greater portion of the border re-enforced by iron straps and joined together by four wooden transoms and eight transom-bolts. A trunnion-piece, *a*, wrought-iron is bolted to the upper side of each cheek, and is provided with a cap-square, key, and chain.

The elevating apparatus is composed of a long iron screw with a square double thread, turning from right to left, and inclined at about 25°. It is terminated at the upper end by a wheel and handle, and turns in two collars fastened one to the front side of the lower transom and the other to the middle transom. The nut *c* travels along the screw throughout its length. The ends of the female screw are provided with rollers, which

n the grooves of channel-beams secured on the inner face of the
s. Two iron rods, *o*, connect the female screw to the breech of the
r, which has a horizontal hole drilled into it to receive a bolt,
ıg an axle around which the rods *o o* move. By this arrangement
s of elevation from 0° to 75° may be given.
e carriage is provided with two siege-wheels and a wrought-iron
which may be raised vertically by means of a hoisting apparatus
ıade to move in two slots formed by an iron bar fastened to the
face of the cheeks. This axle has near each arm a square re-enforce,
a vertical hole in it, in which is placed a bronze female screw with
ble thread; one nut is right-handed, the other left. The hoisting
atus is composed of two vertical screws in the slots *e* passing
gh the nuts in the axle. The screws have on their upper end the
wheel *f*, engaging in the threads of the endless screws, one of which
ıt-handed, the other left, and mounted on the same horizontal shaft,
ı is turned in journal-boxes in the upper part of the grooves by
s of a capstan-handle, *h*, on each end. The axle is guided in its
n in the grooves by a plate of iron, *b*, screwed to the inner face of
xle, between the two shoulders, and terminating in square hooks,
form guides, and slide in the grooves.
e hoisting apparatus is used either to lower the carriage on the
rm by raising the wheels so that they do not touch, or to raise the
ge by bringing the wheels on the ground. Four men at the handles
e screw are sufficient to do this work. To lower the mortar on the
rm, it is necessary to raise the wheels only from $\frac{1}{2}$ to $\frac{3}{4}$ of an inch,
eas for transportation of the mortar the carriage must be raised
iently to attach it to the limber. This is done by means of a trail,
T-iron. This has a lunette at one end, and is made fast to the mid-
ansom by means of a bolt, *l*, and to the rear transom by two iron
n, between which it is held. A 15-centimeter gun-limber is used.
e wear on the female screws in the axle is diminished by means of
ps with screw ends; the axle is lowered to its lowest point in the
e, the ends of the stirrups are passed through holes drilled in the
o the right and left of the shoulders, and the threaded ends are
ed into double nuts, which are jammed hard. The middle part of
irrup fits in a notch, *q*, cut in the lower end of the screw, and pre-
it from turning.
ere are several other irons on the cheeks: two priming-wire eye-
four equipment-rings, *i i*, two hooks, *t*, and a ring, *u*, for the lock-
four plates, *p p*, at the rear, two of which are on the outer face of
heeks and two on the rear face; they present a kind of cup turned
ward, in which the hook of the roller-handspike engages. The
front transom and rear transom are provided with pointing-plates.
ight of carriage, 4,457 pounds; the carriage and mortar, 11,125
ds. Height of the axis of the trunnions above the platform in firing
on, 54 inches. Length of the cheeks, 80 inches. Total length from
ont part of the wheels to the end of the trail, 158 inches.

Krupp's. (Plate XLIII.)

upp's carriage for what he designates as his 28-centimeter (11-inch)
zer is arranged to enable the gun to deliver a direct fire over a
et as a gun mounted in an ordinary barbette battery, and to fire
nortar at an angle of elevation of 75°.
e carriage in its general construction is similar to that made for

sea-coast guns, with such modifications as became necessary to fit it for the special service required of it.

To enable the chassis to resist the strain brought upon it in firing at elevations of 75°, the rails are made to bear evenly on four traverse-circles laid in the platform, distributed at equal distances from each other. The rear traverse-wheels are mounted on eccentric axles, and when the gun is to be traversed these wheels are thrown in gear, and when the proper horizontal direction has been given to the gun they are thrown out of gear, and receive none of the shock of the recoil. The means for traversing the chassis are the same as in the sea-coast carriages, namely, a windlass and chain made fast to the platform near either end of the outer traverse-circle. The pintle is in the front transom.

In order to preserve the axis of the gun at the proper height above the platform to enable the gun to fire over parapets of the usual construction, it is necessary to make the top carriage as much higher as the top of the chassis has been lowered. To give the different elevations ranging from 0 to 75°, a circular rack is fixed to the under side of the gun, the center of the rack being at the intersection of the axis of the trunnions with that of the gun. A cog-wheel engages in the teeth of the rack, and is operated by two wheels on the outside of the cheeks, the same as in the sea-coast carriage. A graduated arc is attached to the outside of the left cheek, just under the trunnion; an index about 11 inches in length is made fast to the left trunnion, and indicates the elevation of the gun. The means for checking the recoil, running the gun from battery, hoisting the shot, &c., are the same as in the other carriages for heavy guns.

RUSSIA. (Plate XLIV.)

The 6-inch-mortar carriage represented in Plate XLIV, as well as the 8-inch, which differs from this only in the dimensions, were designed by Colonel Semenoff. It is composed of two cheeks of boiler-plate 1 inch thick, connected by five bolts, with pipes, forming transoms, two above and three below. The trunnion-bed is formed by re-enforcing the hole cut in the plate with a flat piece of iron on the outside and an angle-iron (Fig. 9) on the inside. The trunnion-bed is secured to this by means of rivets with countersunk heads, and inside of the angle-irons are the battens, (Fig. 3,) with screws on the end for holding the cap-squares.

The lower edge of the cheek is re-enforced both on the inside and outside by angle-irons, and shod with a flat bar fastened by rivets with countersunk heads. Two guides are fastened to the angle-irons in front and rear, and serve to guide the carriage in its motion by pressing against the directrix, which will be mentioned hereafter.

The elevating apparatus is composed of an arc fastened at each end to the mortar, having teeth which engage in a pinion mounted on an axle turned by two handles outside of the cheeks, (Fig. 1.) Two cannoneers, one on the right and the other on the left, give the elevation by turning the two handles at the same time. The angles of fire are embraced between 5° depression and 73° of elevation. A clamp-screw on the left end of the shaft prevents the gun from moving after it has been pointed.

To load the mortar, it must be brought after firing to nearly a horizontal position. The use of a gunner's level each time is avoided by having a graduated bronze arc fastened on the outside of the cheeks, just under the right trunnion, (Fig. 10,) and an index marked on the face of the trunnion.

In firing, the carriage slides on the platform; or, for the facility of running it into battery and moving it laterally, it may be mounted by means of four truck-wheels on a kind of low chassis or directrix, (Fig. 4.) The two front wheels, mounted on the same axle, are just over the top of the chassis, but do not touch it; the rear wheels are mounted each on a crank-axle, (Fig. 5;) a forked lever, which can be brought down between the cheeks, serves to bring the wheels in contact with the tops of the directrix.

To cause the carriage to run on its four wheels, it is sufficient for a cannoneer to force the forked lever down to the rear; the rear end of the carriage is thus raised, and the front wheels are made to bear.

The directrix (Fig. 4) is composed of two wooden beams, covered on top and sides by plates of iron, and joined by two wooden transoms and three bolts. Near the front end is an iron axle, with a vertical hole in its middle for the pintle, and provided with two traverse-wheels which rest on the front traverse-circle of the platform. Two hurters, attached to the front end of the directrix, stop the carriage in its motion into battery, and two counter-hurters, placed in rear, limit the recoil when firing at low angles. Near the middle, between the two beams, is placed a traverse-wheel, which travels on the rear traverse-circle. The directrix is provided underneath with four cross-sleepers, which prevent its bending under the weight of the carriage.

The length of the directrix will allow a recoil of 9 feet, which is sufficient for the maximum charges with a dry platform at angles greater than 20°, and with a damp platform at angles greater than 45°. For less angles it is necessary to throw some sand under the carriage.

To give lateral motion to the mortar, if only a slight motion is required, insert the end of the lever in the holes in the rear traverse-circle and press against the carriage. If, on the contrary, it is desired to move the carriage through a great angle, the directrix is traversed on its wheels by three or four men pulling on a rope fastened to its rear end.

The platform. (Plate XLV.)

The platform originally adopted was fan-shaped; nine sleepers semi-circular in cross-section were placed crosswise, four toward the front, three in the middle, and two in rear, seen in cross-section in Fig. 1, (Plate XLIV;) eleven round sleepers were laid on and slightly let into them; nine of the round sleepers were laid down in the shape of a fan, and the other two halved into the others formed the rear oblique sides of the platform. On top of the eleven sleepers, and slightly let into them, were laid thirty-two 6-inch square scantling of variable length, according to their position, the ends cut off obliquely. The last sixteen scantling were secured at their ends by two hurter-planks let into the scantling and held by bolts. The front scantlings were secured in the same way, only the hurter-plank was not let into the scantling. In rear of each sleeper a large picket was driven. Near the front end of the platform the pintle-plate and friction-circle were placed and screwed fast, and near the middle of the platform a second traverse-circle with oblong holes in it.

The length of the platform was 16 feet, its slope to the rear 1½°, and the lateral field of fire 90°. This platform, which is still provisionally used in sea-coast batteries, has been recently replaced in siege and garrison batteries by a simpler one, which has been tested since 1873. This last is formed of two rectangular parts of unequal width. It is composed of nine sleepers (Fig. 4) 6 inches square, laid down lengthwise

and covered with twenty planks 3 inches thick and 9 inches wide; seven sleepers, five in the middle and two at the edge of the platform, are 15 feet long, and extend from one end to the other; the remaining two are 7 feet 9 inches long, and support only the rear plank.

The sleepers rest on the heads of fifty-eight pickets 2 inches in diameter and 3 feet long, driven into the earth. Two cross-pieces are placed under the front ends and middle of the seven long sleepers; that under the middle supports the front ends of the short sleepers, also the traverse-circle and the rear end of the carriage.

A cross-timber is placed in rear of the sleepers, and is held in place by five pickets 4 inches square and 5 feet long, driven into the earth; nine of the deck-plank are 6 feet long and eleven are 8 feet; these last extend one foot alternately to the right and the left, so that the rear part of the platform is 10 feet wide. The plank are nailed with seventy-five nails, and the whole rendered secure by sixty-one pickets driven at the ends of the sleepers and the planks.

The pintle-plate and friction-plate are held in front by wood-screws, the latter by eleven screws. A second traverse-circle, with oblong holes in it, (the inner radius being 6 feet,) is let into the deck-planks and held by nine screws, the heads countersunk. The recesses for the plate and circles, as well as the holes for the nails, are prepared and bored in the planks before they are laid down. The platform is made of pine, and is tarred, with the exception of the pickets. It has a slope to the rear of 3°. The front end is 8 feet below the crest of the parapet, and it has a lateral field of fire of 30°. The total weight of the platform, including a number of spare parts, but not the pintle and traverse-circles, is 3,042 pounds.

The traveling position of the carriage.—For transporting the mortar and its carriage an axle has been fitted to the latter for two wheels, and a movable trail intended to hitch on to the siege-limber is used, (see Fig. 1.) Fig. 3 shows how the axle is held in the boxes cut in the front edge of the cheeks by means of cap-squares and bolts. The movable trail is represented in Fig. 1, with its lunette, its friction-plate, and lashing-ring. It is put in place by unscrewing the two rear bolts of the carriage, bringing the trail in position, replacing the bolts, and securing them by the nuts.

The mortar being in battery, to put it in traveling position it is run back to the rear of the platform; the axle and trail are put in place. The front of the carriage is raised by means of a jack put under the middle of the axle, blocking up with blocks till it is high enough. The rear end of the carriage is raised with two jacks, or by means of a lever-bar passed under the carriage crosswise. The wheels are put on and the limber hooked. A seat for the driver is placed on the forward end of the trail, in front of the pintle; in the box under this seat the handles of the elevating-screw are carried; they have to be removed to admit the wheels being put on. The axle is provided with a bucket-hook.

The siege-limber is arranged so as to be drawn by ten horses. In rear of the fixed splinter-bar, with its two swingle-trees, a longer splinter-bar is made fast, and provided with two swingle-trees. The pole has a movable double-tree at its end with three swingle-trees; the front horses are hitched to the traces of the three middle ones. Two lock-shoes for the rear wheels are carried on the body of the limber.

The directrices of the mortar-carriages are carried by themselves in siege-wagons; four can be carried in one wagon.

Weights, &c.

	Pounds.
Weight of the carriage with mortar and limber	8,893
Weight of the mortar	3,461
Weight of the carriage without trail, axle, or wheels	2,692
Weight of the trail and seat	3,373
Weight of the axle with two wheels	1,030
Weight of the siege-limber	1,373
Number of horses to draw the carriage	10
Whole length of the carriage to the end of the pole	23 feet.
Width of the carriage	76 inches.
Diameter of the front wheels	56 inches.
Diameter of the rear wheels	62½ inches.

Old pattern.

The top carriage is made of a single thickness of boiler-plate, about ½ inch thick for the 6-inch mortar. This plate is strengthened by angle-iron riveted to it around its outer edge. The trunnion-plates are riveted to the cheek-plates, and are graduated into degrees and quarters, and serve in place of a quadrant to determine the elevation of the gun, the index being made fast to the trunnion. The cap-squares are keyed in place like those belonging to the field-batteries.

A circular iron rack is fastened to the under side of the gun in the vertical plane through its axis, the center of the circle being in the axis of the trunnions. A cog-wheel which engages in the teeth of this rack is on a shaft passing through the two cheeks at right angles to them and near their front edge; it is operated by a crank-handle outside of the cheeks.

The rollers are on the inside of the cheeks, the rear one being on an eccentric axle. When this is thrown in gear the rear part of the carriage is raised, and its weight is brought on the front and rear rollers. The rear transom has two guides which project down on the outside of the chassis.

The chassis is composed of two wooden rails connected by transoms. They are shod with iron on top and on the outer sides, to prevent chafing. The chassis is narrow, being of less width than the top carriage, and rests directly on the platform. It is traversed by means of a block and tackle made fast on either side of the platform, or by handspikes.

SLING-WAGON.

ENGLAND. (Plate XLVI.)

The iron sling wagon is composed of a perch, two sides and two cross-pieces, two cheeks, an axle, and axle-body. The perch and sides are of girder-iron, and are connected by a cross-piece, also of girder-iron, riveted to them in front, and by the axle which is riveted to them in rear; also, by a stay of round-iron from the perch to each side.

The axle is arched, to give greater room under it, and has in the middle two lugs which receive the perch and the rivets to secure it, also, a projecting piece at the shoulder for riveting it to the side. The cheeks are of T-iron, and are riveted to the sides; they support the windlass directly over the shoulders of the axle. The perch has a lunette by which the rear wheels are connected with the limber. A windlass of elm, cylindrical except at the ends, where it is octagonal, is provided with ratchets and handspike sockets. It has a hook at its middle, to take an eye in the middle of the sling. Two similar hooks are on each

end of the axle-bed, to take the ends of the sling. The handspikes are 80 inches long; two of them have 15 feet of 2-inch rope made fast to the small end. The windlass is worked, in raising the load, from the rear of the wagon.

The limber is wholly of iron. The axle-body is built up by riveting two plates on the sides of the axle, with the pintle between them, and covered with a top-piece. The three futchells of T-iron are riveted to the axle-body, and bolted to the splinter-bar; this is made of plates, trough-shaped, and strengthened by a stay of round-iron at each end, connecting it to the axle-body. The wheels are wooden, with bronze nave boxes and wrought-iron flanges.

Principal weights and dimensions.

Weight of sling-wagon	4,760 pounds.
Weight of sling-wagon wheel	777 pounds.
Diameter of sling-wagon wheel	7 feet.
Diameter of limber-wheel	5 feet.
Width of tire of wagon-wheel	6 inches.
Width of track	71 inches.

RUSSIA.

A sling-cart was seen at Aboukoff, where the large steel guns are made. It was used for transporting 9-inch guns to St. Petersburg, and was of iron throughout, cast-iron naves, spokes of round bars, and broad tires, 14 inches in width, of rolled iron.

The means used for hoisting the gun were two strong screws, which were operated at the same time by a pinion placed between them, and engaged in teeth on a nut on each screw.

COLONEL LISCHINE'S WOODEN TENT. (Plate XLVII.)

The model of this tent in the Russian exhibit at Vienna is of peculiar construction, and found much favor among military men.

The frame is of iron, and is covered with thin pieces of board 10 feet long and 1 foot wide, overlapping each other like Venetian blinds. The ridge is of canvas. The iron frames are four in number. It has the advantage of being cheaper, more durable, warmer, capable of better ventilation than the canvas tent.

T. T. S. LAIDLEY,
Colonel of Ordnance.

Machine for making Pebble Powder.

Fig. 2.

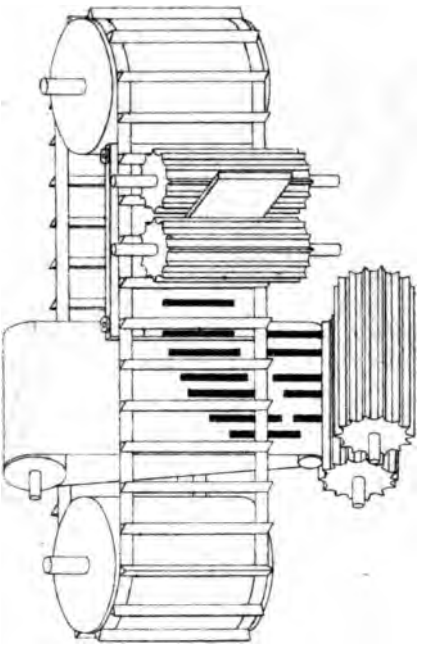
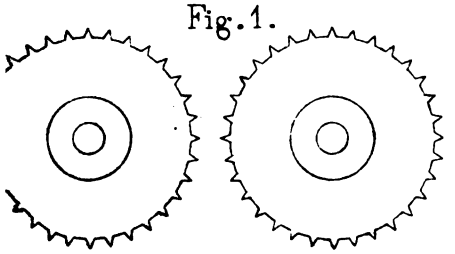
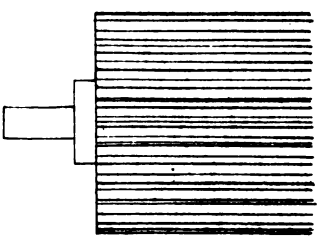


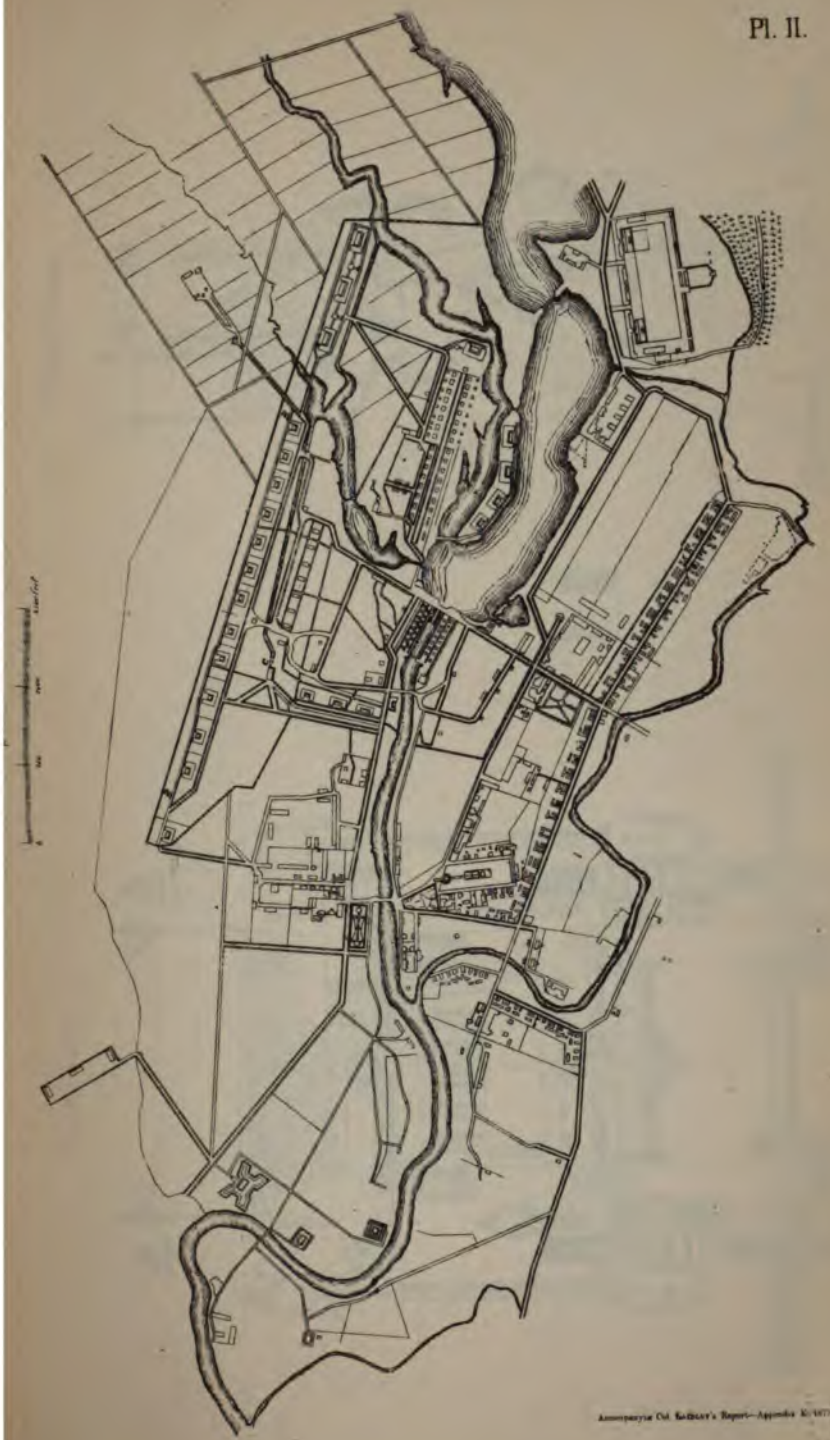
Fig. 1.



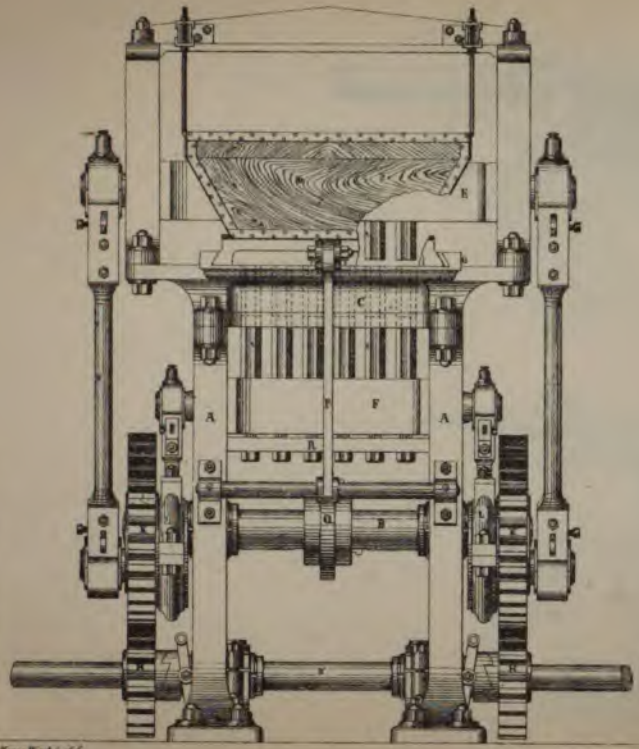


Accompanying Col. Laidley's Report—Appendix K, 1877.

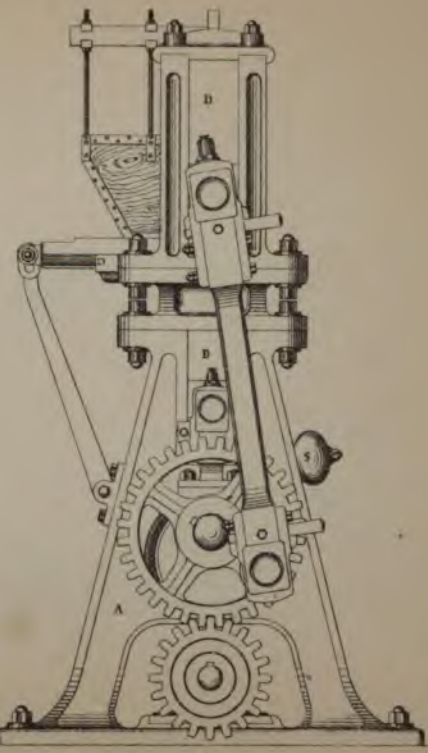
Pl. II.

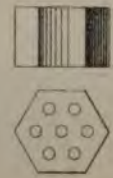


Front View.



Side View.

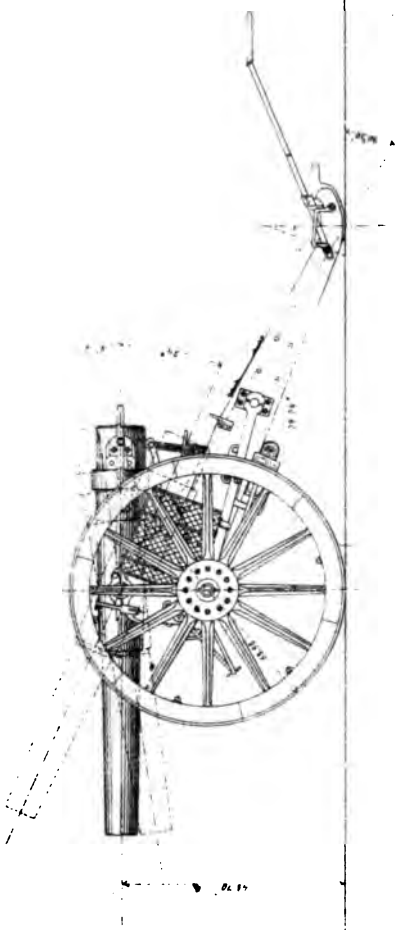




Pl. III.

Accompanying Gil Lowery's Report—Appendix K, 1867.

AUSTRIAN FIELD CARRIAGE.



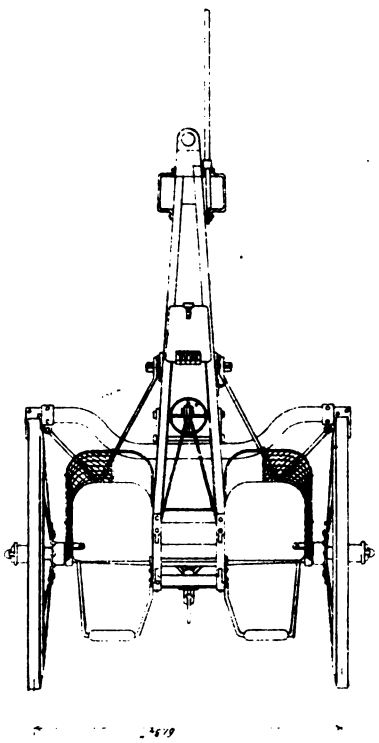
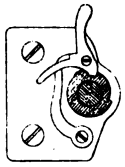


Fig. 7.



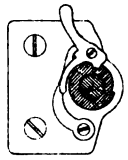


Fig. 4.

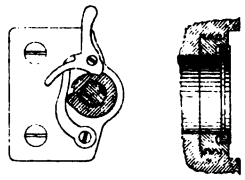


Fig. 6.

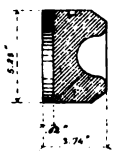


Fig. 5.

Fig. 1.

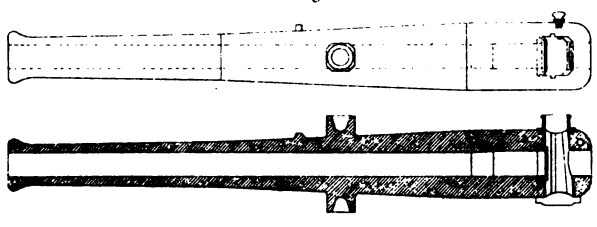


Fig. 2.

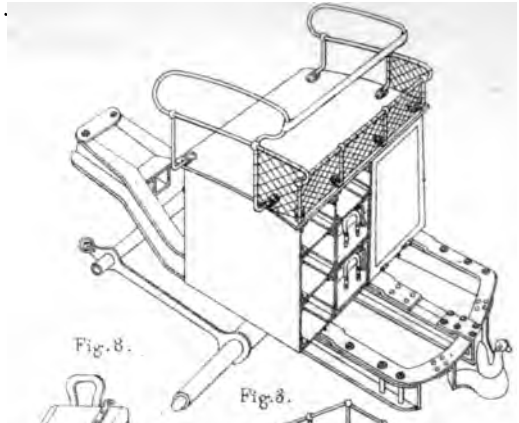


Fig. 8.

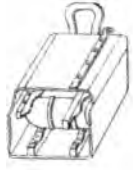
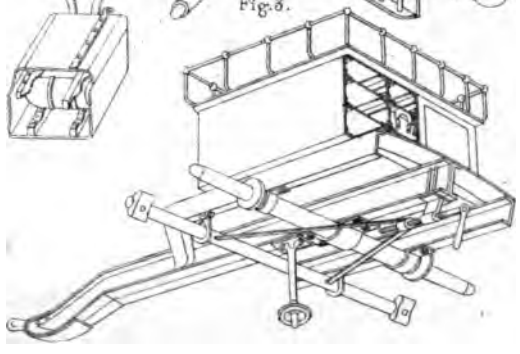
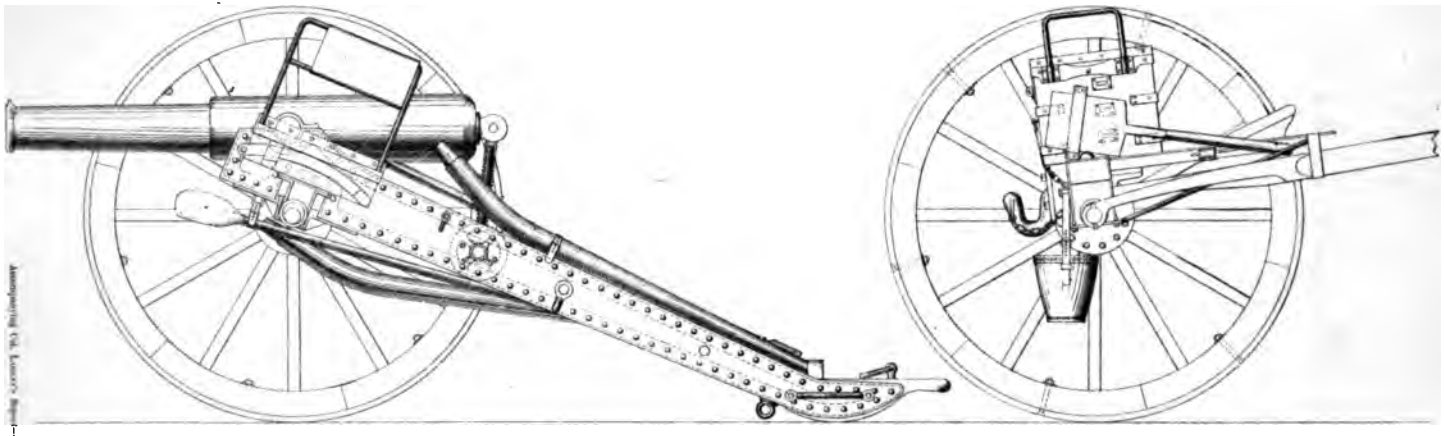


Fig. 3.



English 9-pdr. Field Carriage.



Scale.

Inches 0 1 2 3 4 5 6 Feet.

Pl. VI.

Accompanying Ch. Lucas's Report—Appendix K. 1-27.

English Field Carriage Wheel.

Fig. 1.

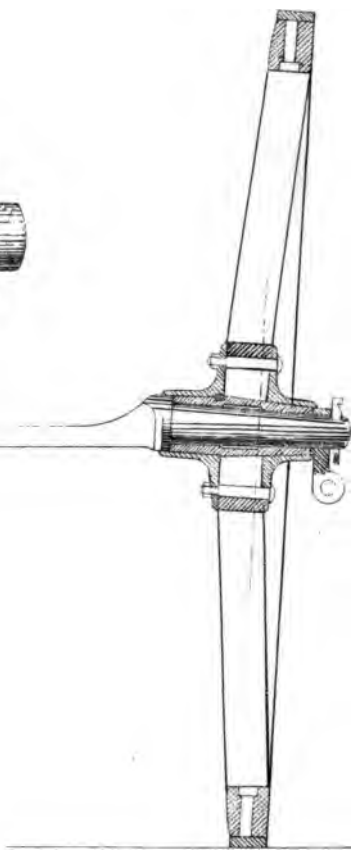
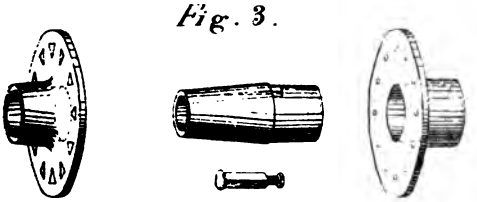


Fig. 3.



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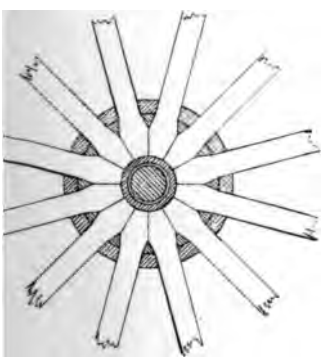
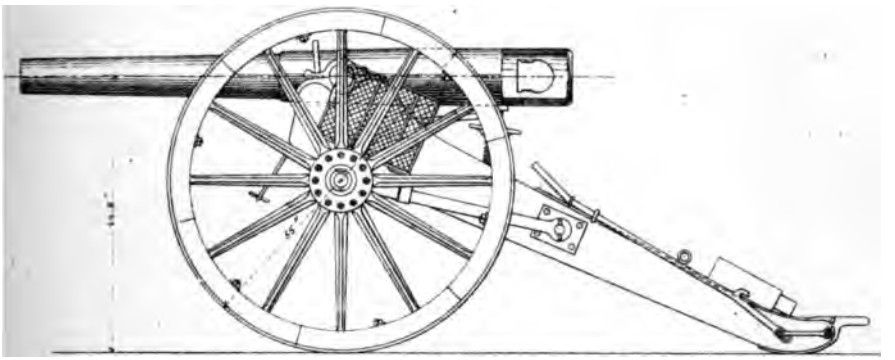
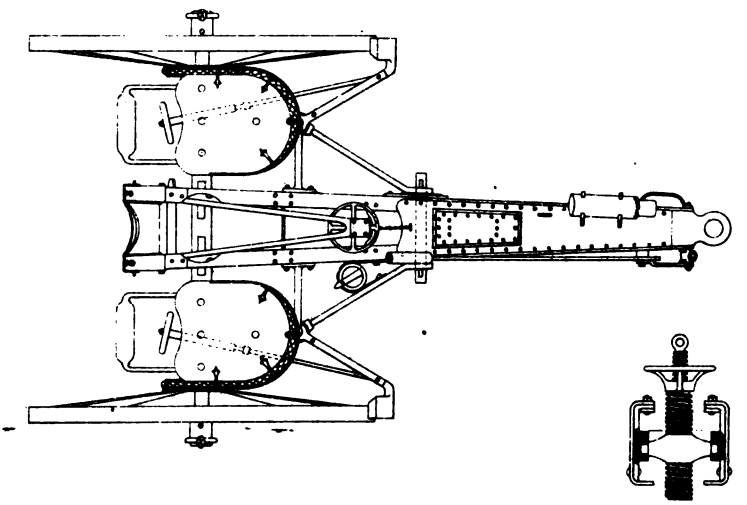


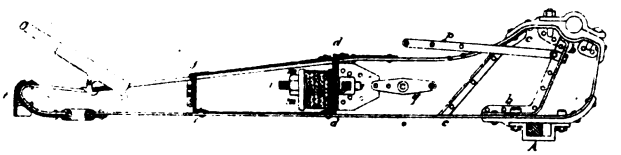
GERMAN FIELD CARRIAGE.





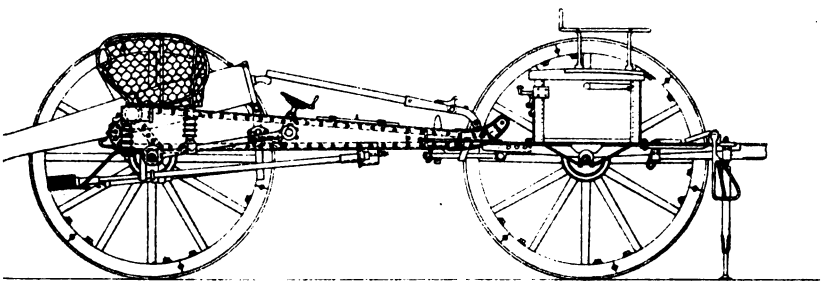
Pl. IX.

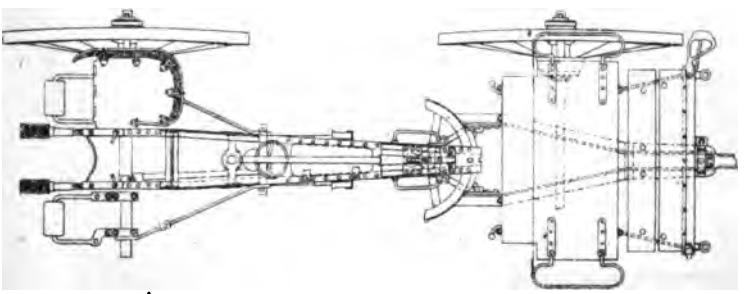
ENGELHARDT'S FIELD CARRIAGE.



Pl. X.

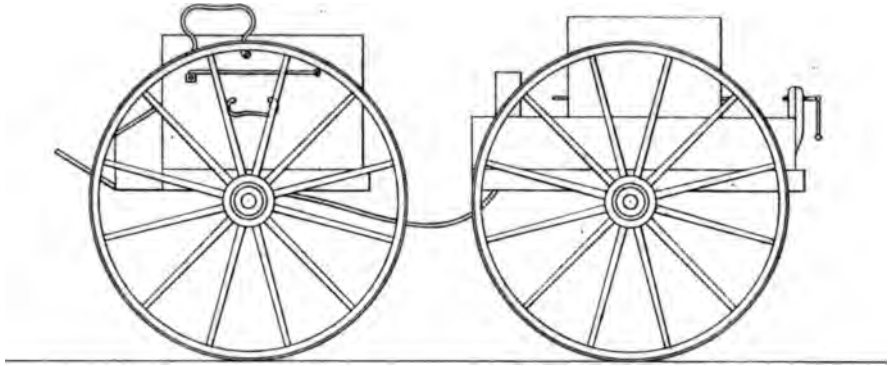
Swedish Field Carriage.

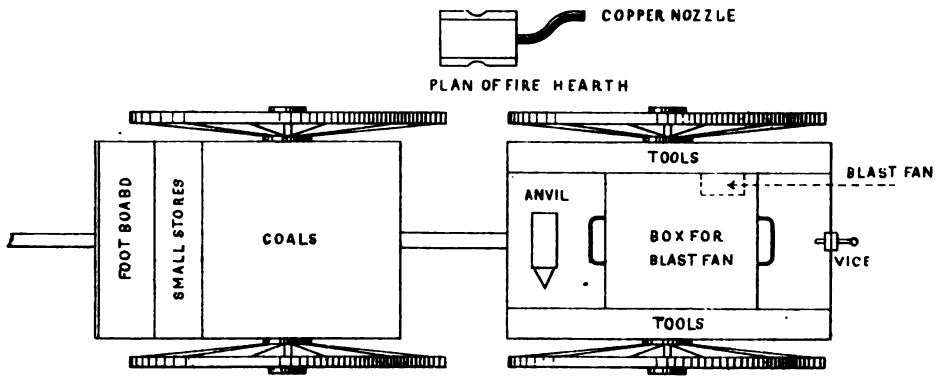




Accompanying Col. Lambert's Report—Appendix K, 1877.

SWEDISH TRAVELLING FORGE.

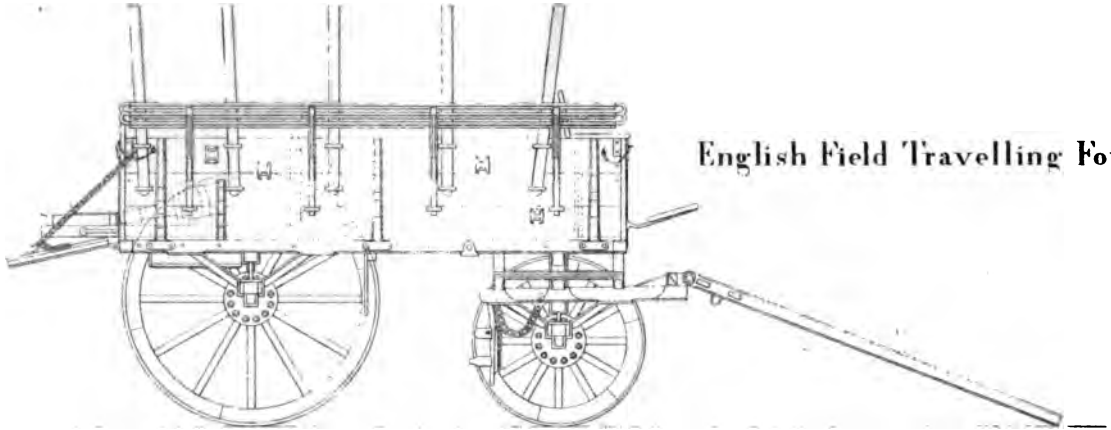




Accompanying Col. Laidley's Report—Appendix K. 1877.

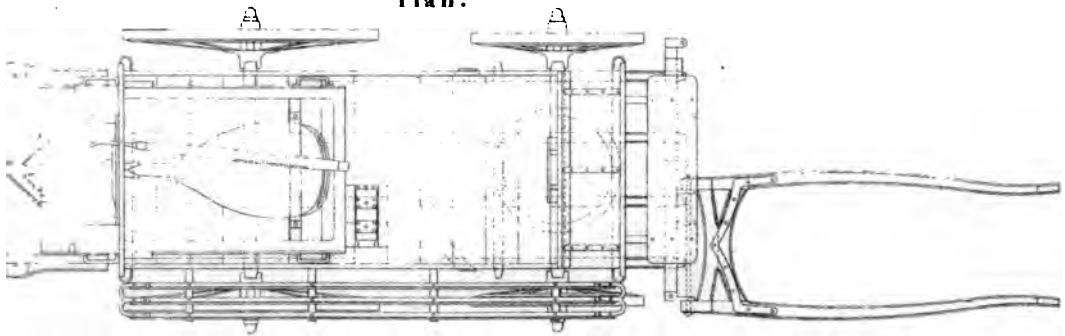
Pl. XI.

Side View.

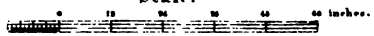


English Field Travelling Forge.

Plan.

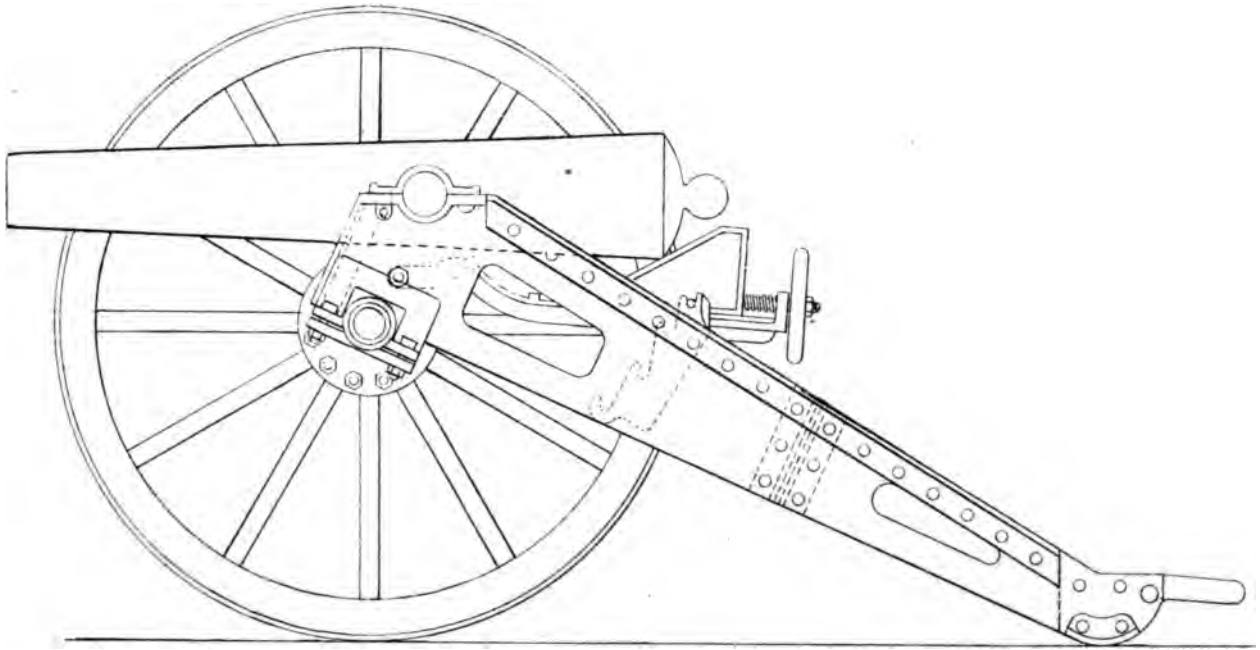


Scale.



Pl. XII.

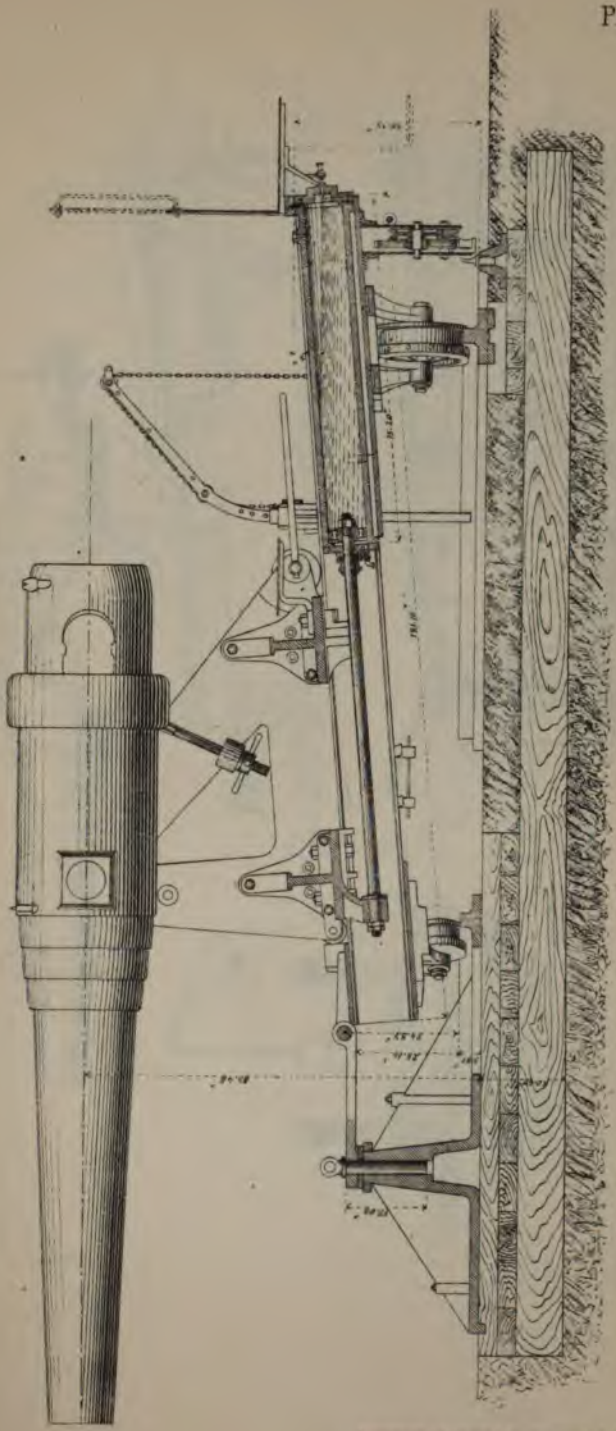
English 7pdr Mountain Carriage. (Wrought iron)

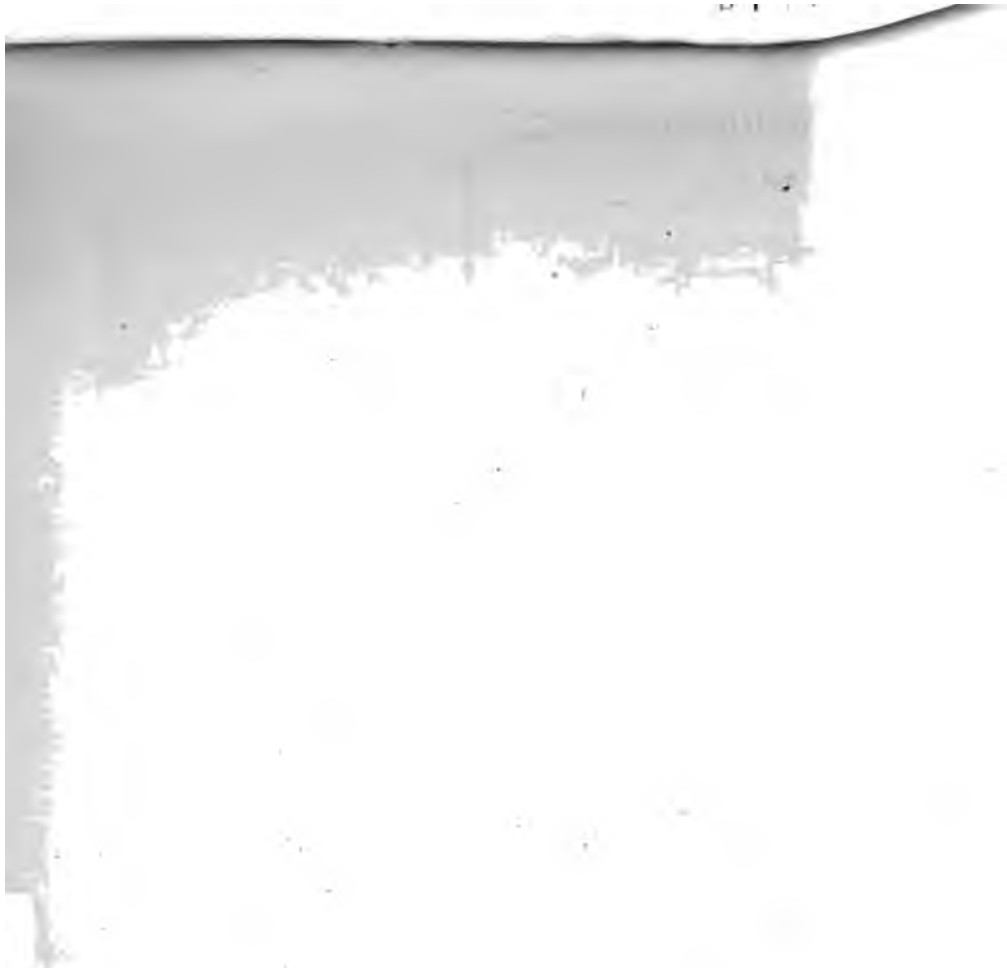


Accompanying Col. Laidlay's Report—Appendix K 1877.

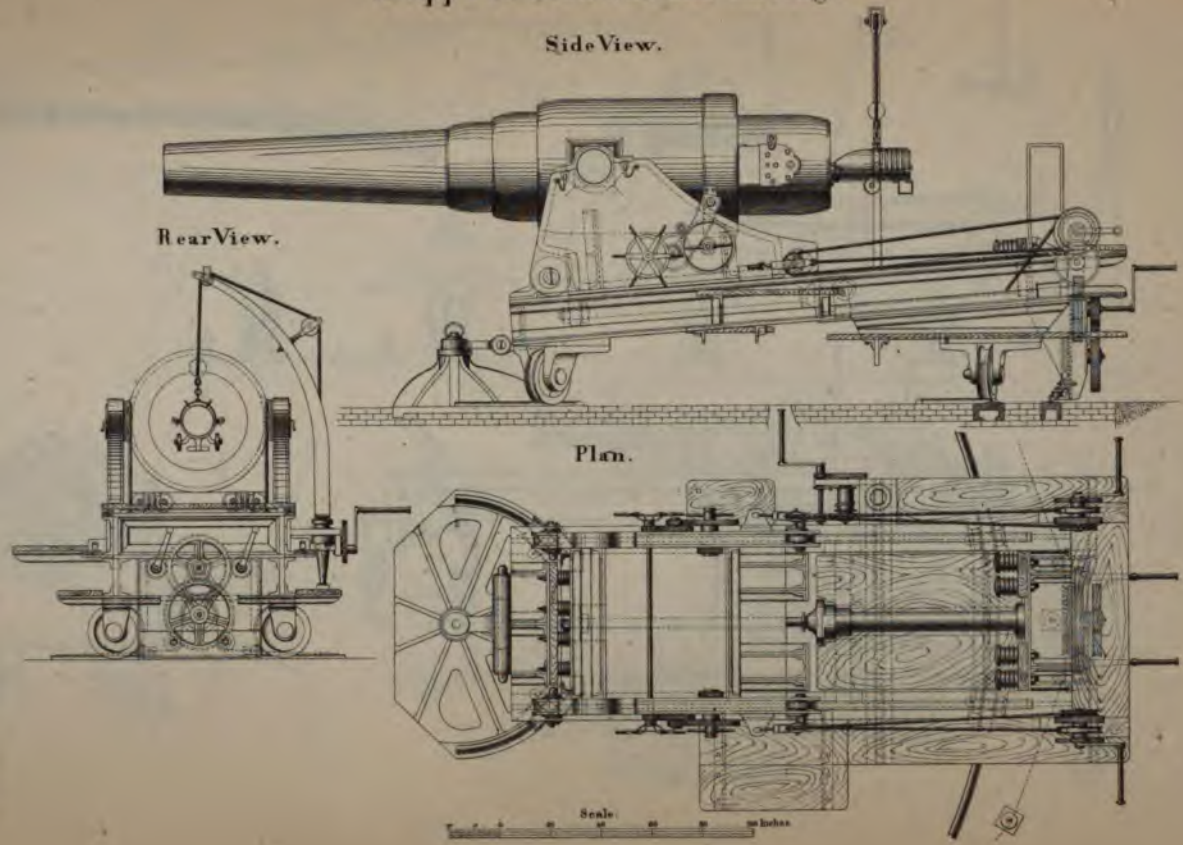
Pl. XIII.

GRUSON'S 21^{c} COAST CARRIAGE.



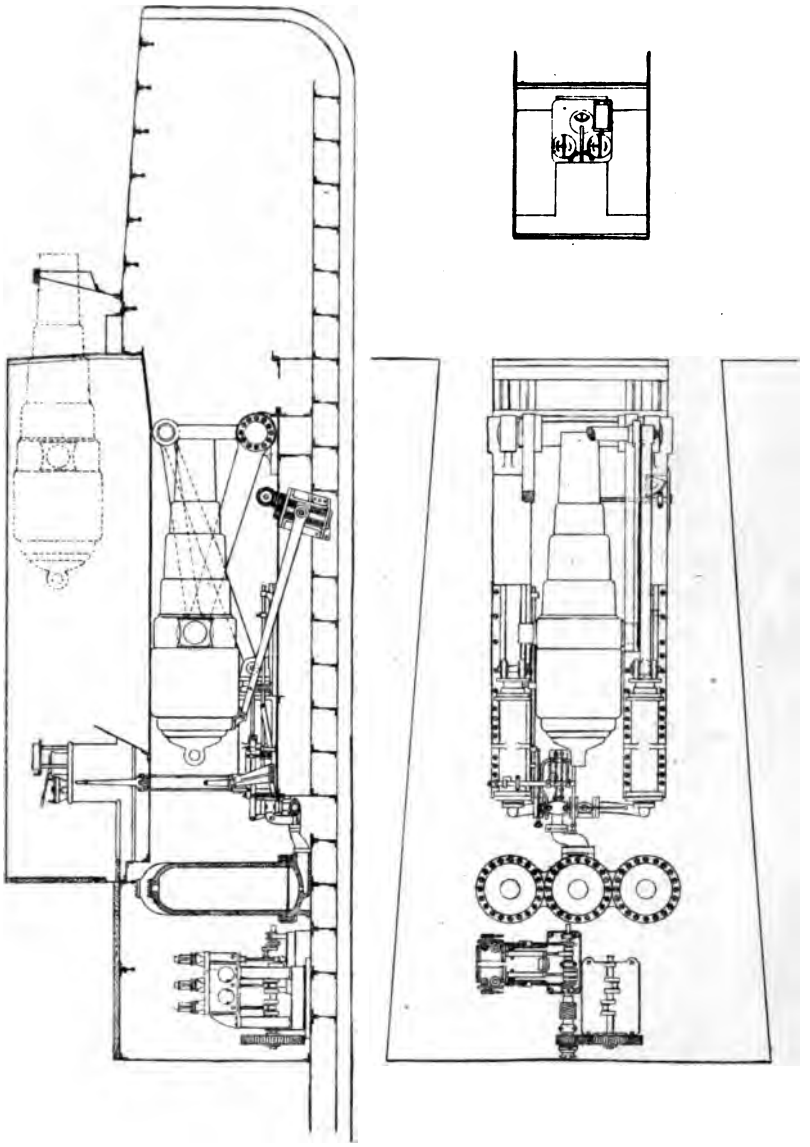


Krupp's 12 inch Gun and Carriage.



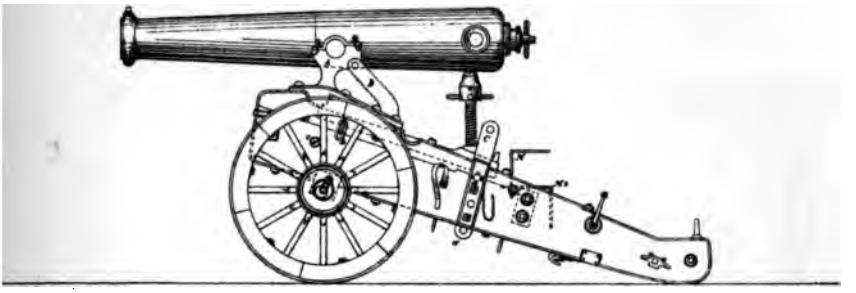
Pl. XV.

Hydro-Pneumatic Ship Carriage.



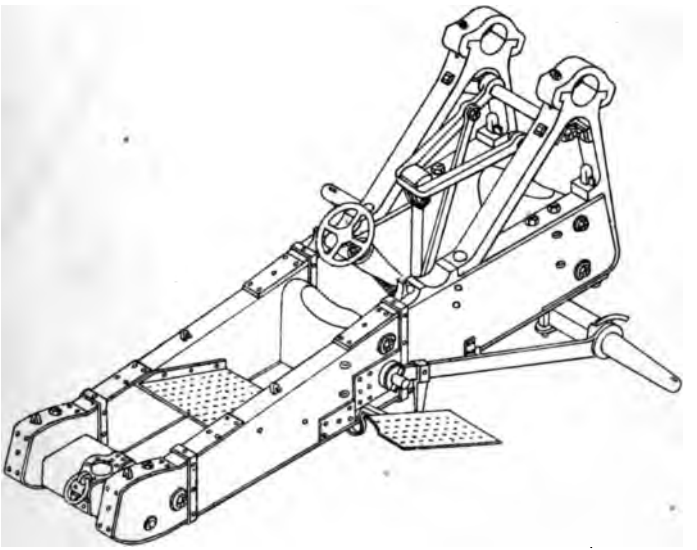
Pl. XXXIII.

AUSTRIAN SIEGE CARRIAGE.

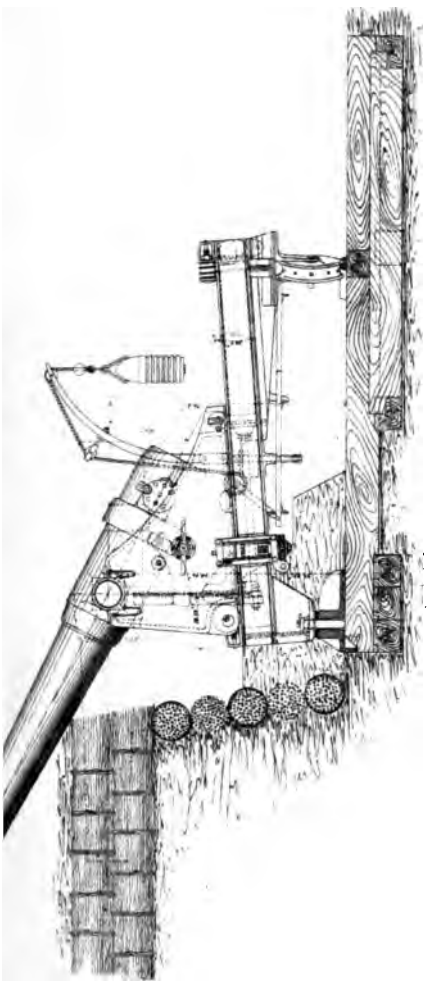


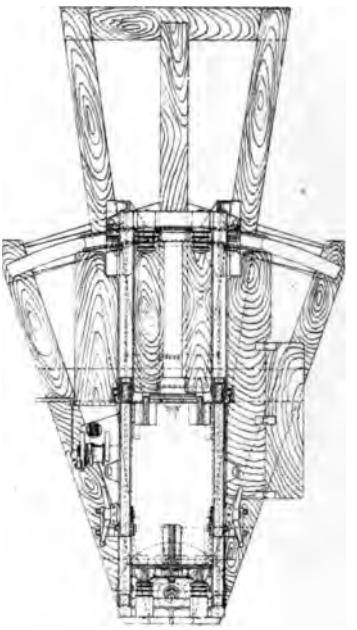
Pl. XXXIV.

Prussian Siege Carriage.

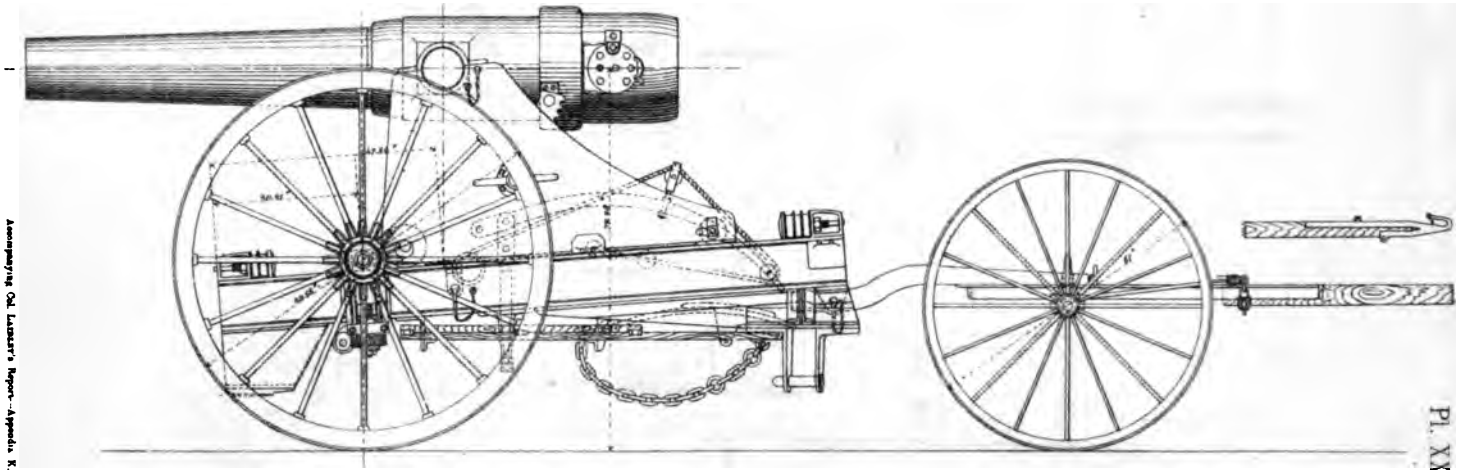


Accompanying Col. LAIDLEY's Report—Appendix K, 1872.



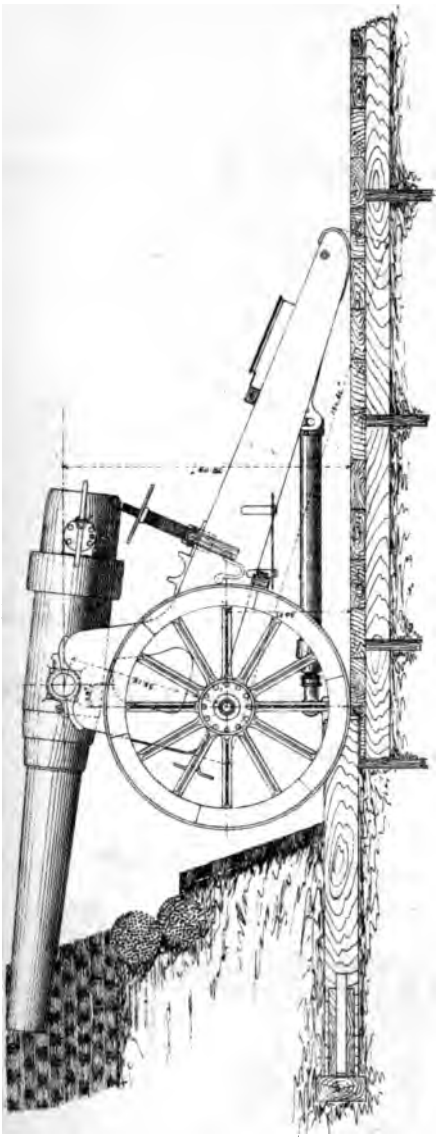


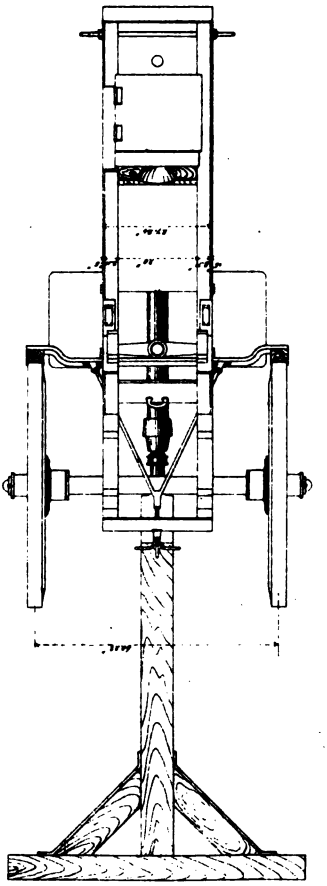
KRUPP'S 21° SIEGE CARRIAGE.



Pl. XXXVI.

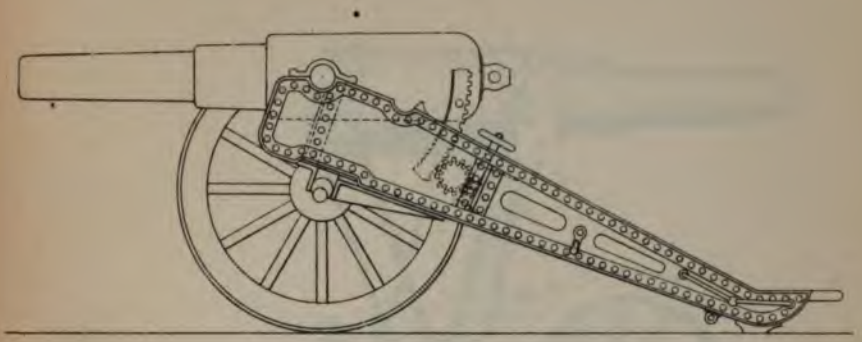
Accompanying Col. LAIDLEY's Report.—Appendix K. 1877.





Pl. XXXVIII.

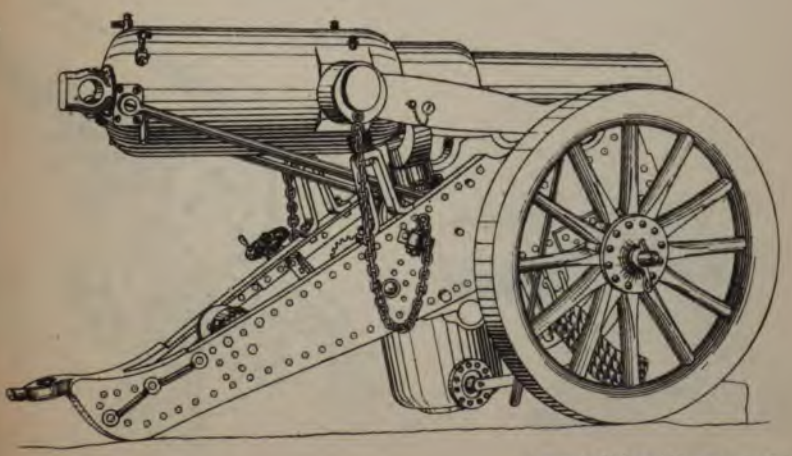
English 40 pdr Siege Carriage. (Wrought iron)



Pl. XXXIX.

Moncrieff's Hydro-Pneumatic Siege Carriage.

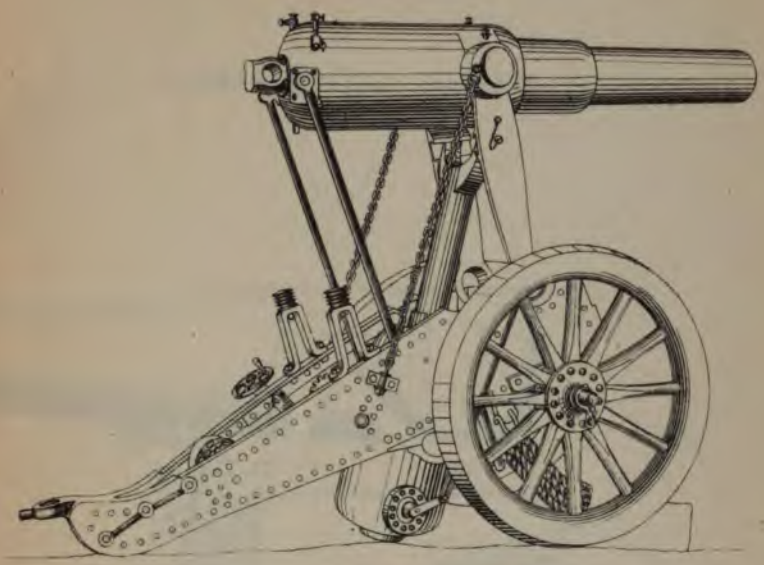
Loading Position.



Pl. XL.

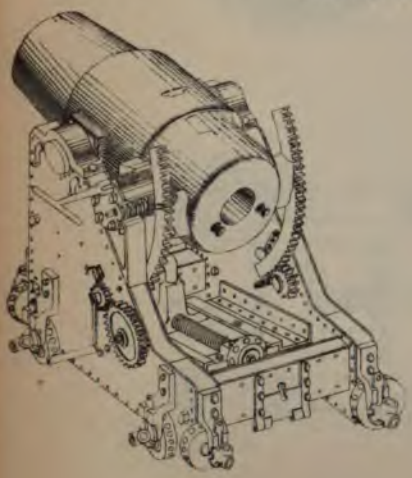
Moncrieff's Hydro-Pneumatic Siege Carriage.

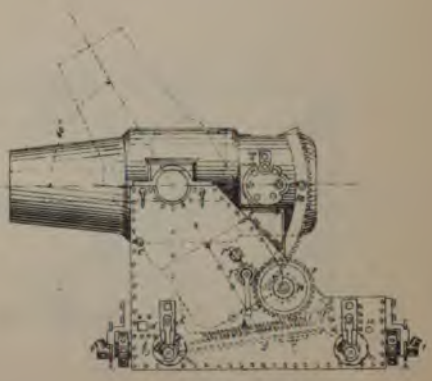
Firing Position.



Pl. XLI.

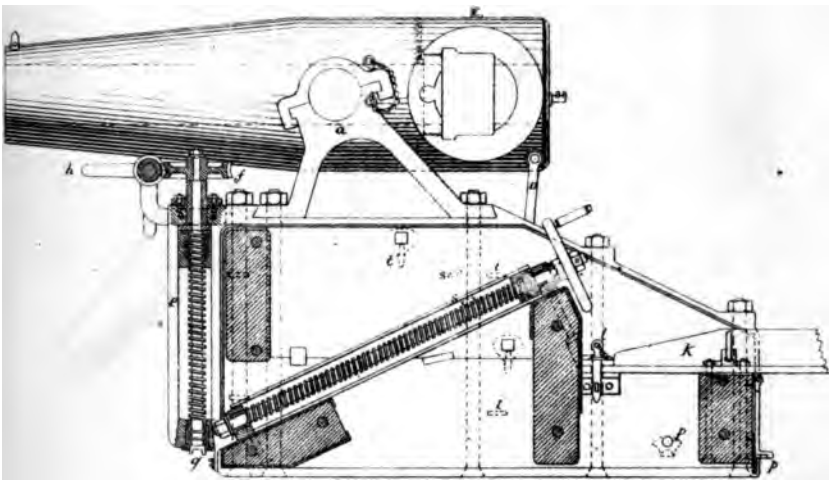
AUSTRIAN MORTAR CARRIAGE.

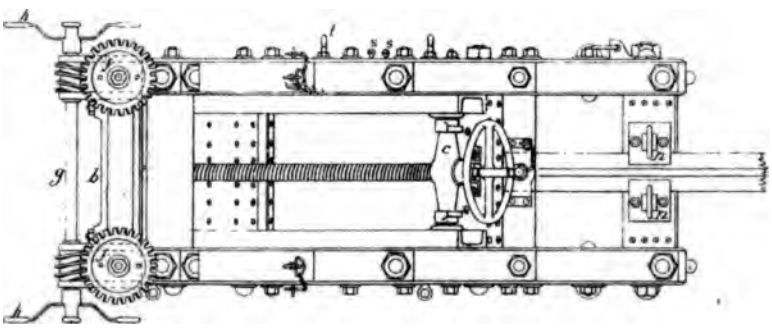


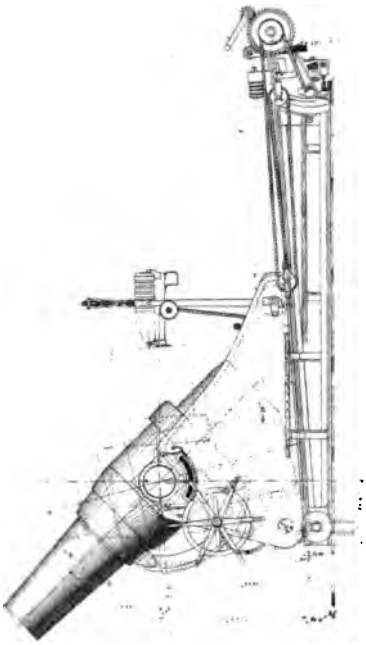


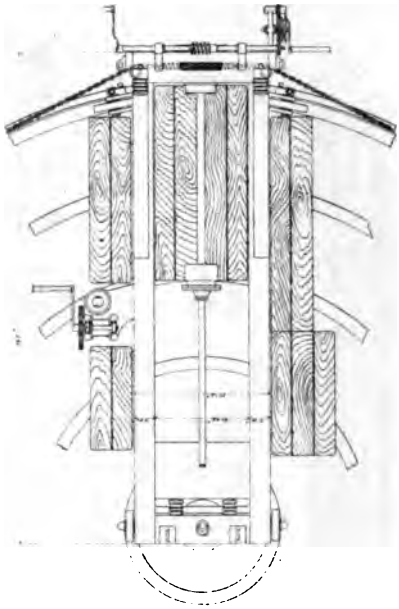
Accompanying Col. Lefroy's Report—Appendix K, 1877.

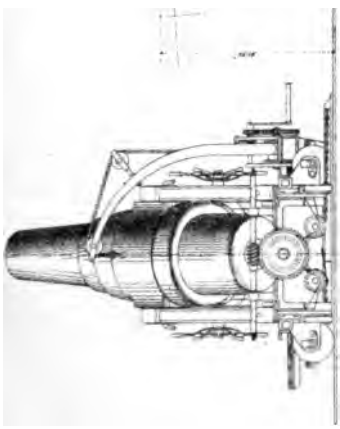
GERMAN MORTAR CARRIAGE.



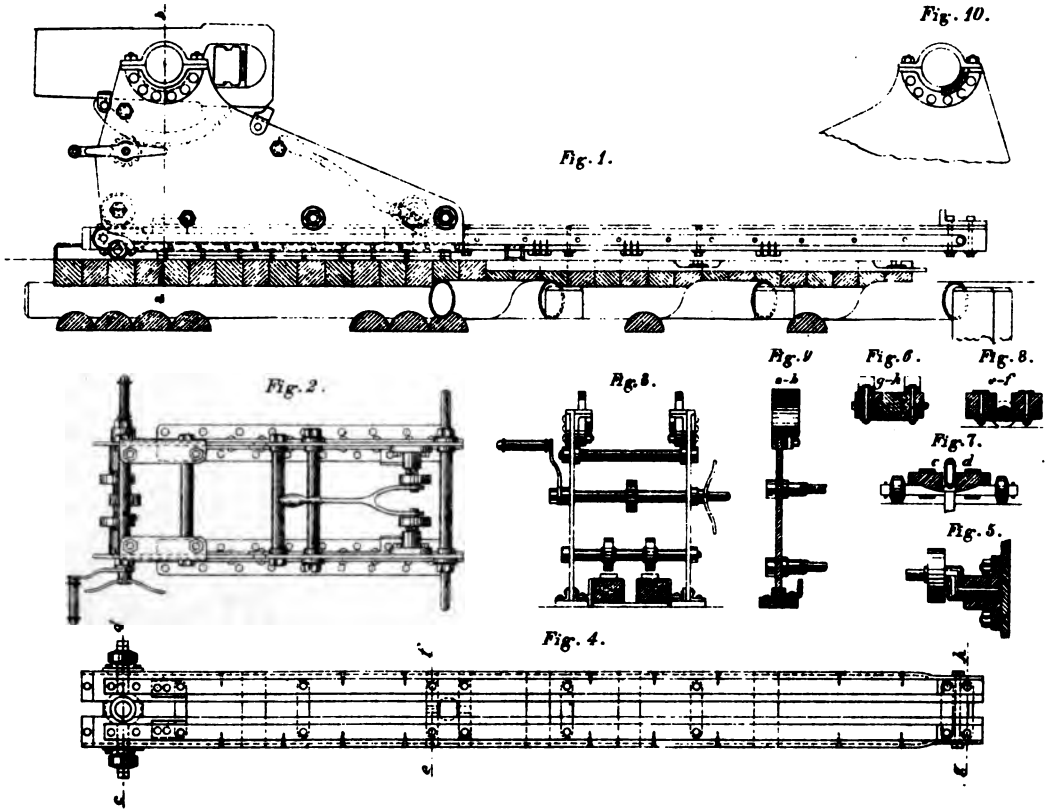








RUSSIAN MORTAR CARRIAGE.



Accompanying Col. LeBlanc's Report—Appendix N. 1877.

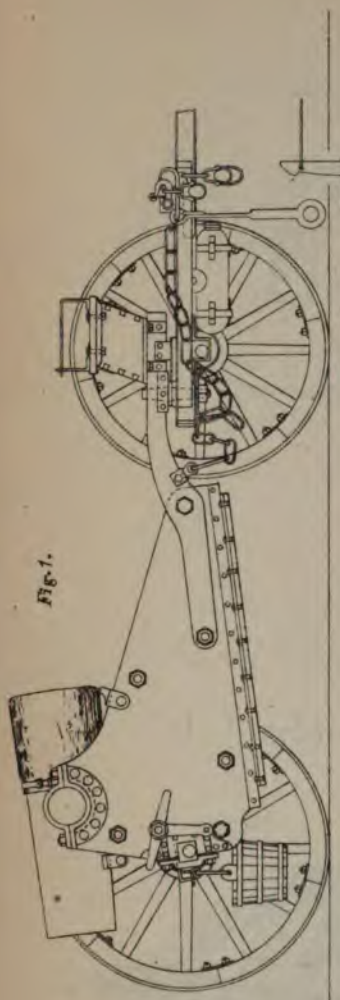


Fig. 1.

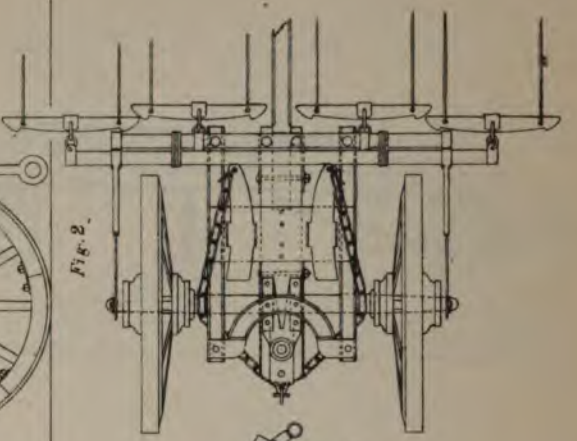


Fig. 2.

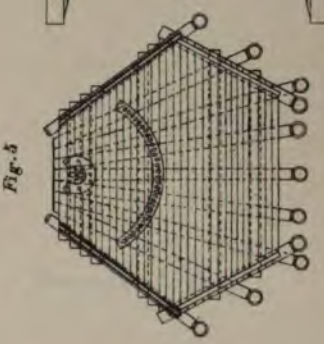


Fig. 5

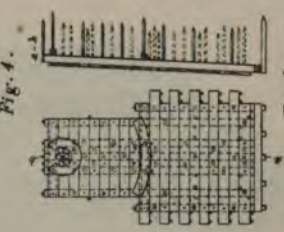


Fig. 4.

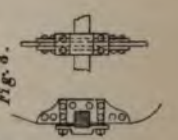
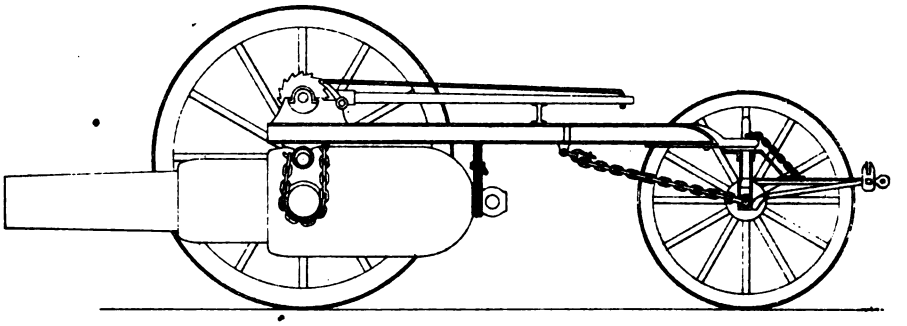
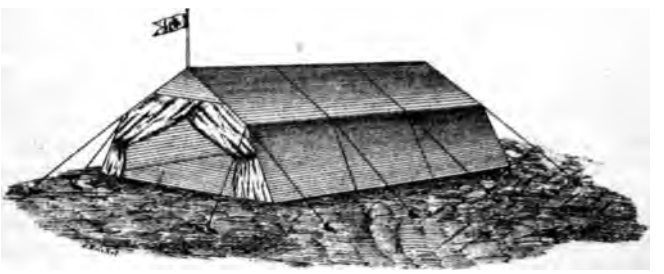


Fig. 3.

English Sling Wagon.



Col. Lischine's Hospital Tent.



APPENDIX L.

Report of Lieut. Col. J. G. Benton, Ordnance Corps, on European ordnance and ordnance stores.

NATIONAL ARMORY,
Springfield, Mass., December 20, 1875.

SIR: I have the honor to transmit a copy of the notes made on my official visit to Europe in 1873, accompanied by a book of drawings made from original sketches.

* * * * * * *

It was the desire of the Russian officials that nothing observed at Cronstadt should be published, but should be regarded as confidential. Hence the marginal notes to this effect.

Very respectfully, your obedient servant,

J. G. BENTON,
Lieut. Col. of Ordnance, Commanding.

The CHIEF OF ORDNANCE, U. S. ARMY,
Washington, D. C.

Extract from Lieutenant Colonel Benton's journal of visit to Europe.

RUSSIA.

Under the guidance of Captain Kalinski, of the Russian army, an officer detailed by instructions of the minister of war, Lieutenant Colonel Laidley, Majors Benton and Crispin, and Mr. Pheiffer visited the several manufactories of ordnance material in and around the city of Saint Petersburg.

The first place visited, on the 29th of July, was the shop where field, siege and the smaller sea-coast cannon are rifled, and the breech-loading apparatus applied to them. The following are some of the points noted, viz: Nearly all the Russian field-cannon, and a portion of the siege-cannon are made of bronze derived from the old muzzle-loading cannon on hand. This material is found to answer well for breech-loading cannon of small caliber, and not to deteriorate as rapidly in firing as in muzzle-loading cannon. A 4-pounder gun was shown that had been fired 3,000 service-charges; the injury to the bore was very slight, scarcely appreciable.

All the sea-coast cannon of the Russian service, and a portion of those employed for siege purposes, are breech-loaders of cast steel built up on the Krupp plan.

The breech-loading apparatus is essentially the same as Krupp's, the larger guns having his cylindro-wedge breech-piece and the Broadwell gas-check.

The rifling is also similar to that of the Prussian system, being composed of numerous grooves of rectangular shape and broader than the lands. An 8-inch gun was observed to have 24 grooves. The width of the lands of the 6-inch mortar appeared to be about .2 of an inch. As a general rule the twist of all the guns is about one-quarter of a turn in the length of the bore. The gas-check ring of the bronze pieces is made of copper, while that of steel guns is made of steel.

The vent of the steel guns is in the breech-piece, and in the line of the axis of the bore, while that of the bronze guns is similarly situated to that of muzzle-guns, extending from the top of the reinforce to near the bottom of the chamber.

As a general rule the front sight is attached to the right rimbase. The rear sight, in addition to the usual vertical motion, can be moved sidewise very considerably to allow for "drift," &c. This motion is made by a thumb-screw, (Fig. 1.)

The projectiles are coated with lead, the surface of which has raised bands or welts to take the rifling of the piece. The body of the projectile is cast as smooth as possible, and after being cleaned in a sal-ammoniac solution is dipped in melted zinc and then in melted tin, after which it is put into bronze molds and the lead coating cast on.

Molds are sent into the field to recoat projectiles that have been used in target-firing. This work is done by soldiers detailed for the purpose.

The cases of canister-shot for rifle-guns are made of sheet-zinc bent into the form of a tube, the edges of which lap over each other to form the seam, and are fastened together with rivets. Before the end is lapped over the bottom it is cut into scollops, as in Fig. 2. The projection (*a*) fits against the shoulder of the chamber, thereby preventing the canister from entering too far into the bore in loading.

The calibers of Russian field-cannon are 4-pounder and 9-pounder. The projectile of the former weighs about 9 pounds, while that of the latter weighs some 27 pounds. The powder-charge is about one-eighth the weight of the projectile.

The only breech-loading mortars thus far made in considerable numbers are those of 6-inch caliber for the siege-service. They are of bronze, and have more the appearance of breech-loading howitzers than mortars. It was understood that a breech-loading mortar of 11-inch caliber was then undergoing experiment.

The only siege-gun observed was of 24-pounder caliber, and made of bronze and rifled. No carriages were observed in this establishment for mortars, but some bronze cheeks for beds for the ordinary 80-pounder bronze mortar were in process of manufacture.

Breech-loading mortars are fired under an angle of 60° if necessary, but in loading they are brought down to the usual angle of elevation.

The general arrangement of the boring and turning room of this establishment is very convenient for the work to be done. It consists of two rows of columns, *aa*, (Fig. 4,) running parallel to the length of the room, which support two galleries, *bb*. On the edges of these galleries are rails for the purpose of supporting a movable transverse railway and lifting-machine, (*c*,) arranged so as to lift and carry the heaviest guns to and from the machines. The chains of this machine are composed of flat steel links, formed by riveting them together at the ends. The power is communicated to the chain by a worm and gear worked by hand. The two rows of columns also support two lines of shafting from which belts run to the machines. An oblique-action steam-engine, *d*, furnishes the power from the center of one end of the room.

Small-arms cartridge-factory.

The next department visited was in the adjoining building where the cases of metallic cartridges are made. The machinery and mode of manufacture are similar to those in the United States, and especially at Bridgeport, Conn. Much of the machinery appeared to have been made in Waterbury, Conn.

The brass from which the cartridges are made is at the present time obtained from the United States, as none manufactured in Russia has thus far been found suitable for this peculiar work, which is all done by men and boys, no women being employed in public cartridge-factories as in this country.

The pay of the skilled workmen is about 4 roubles or $2.80 per day of ten hours. The daily pay of laborers is about one-quarter of this sum.

The primers for metallic cartridges are made at the powder-mills in the immediate neighborhood of the city, and are inserted in the shells before they are sent away to be charged with powder and bullets at another establishment.

To secure work of proper character, each cartridge-shell undergoes twenty-one inspections to verify the quality of material and size of the parts. Many of these inspections are of so simple a character that they are done by boys.

Two calibers of cartridge-shells are made for the Russian army, viz., .42 inch, which is the caliber of the new gun, and .60 inch, which is the caliber of the old rifle-musket altered to a breech-loader. The mode of priming the shells is from the exterior, and is known in this country as the "Berdan system of priming."

For target-practice, each soldier is allowed 240 .42-caliber cartridges per annum, or 140 of .60-caliber. These numbers include the repriming and reloading of the shells, the operations of which are performed by soldiers detailed in each regiment for the purpose.

The .42-caliber shells are loaded with Frankford (United States Arsenal) loading-machines, while those of .60-caliber are loaded with machines of different construction, the peculiarity of which is that the shell is carried by machinery from the room occupied by the workmen into another room, where it is charged with powder, after which it is returned and the bullet is inserted and fastened into the shell. The .42-caliber cartridge-shell is bottle-shape, and its mouth undergoes a final annealing in a sand-bath, to permit the metal to expand, without cracking, into the mouth of the chamber of the gun, and thereby prevent any escape of gas backward from the powder-charge in firing.

A very ingenious machine was observed in operation, which automatically separates or throws aside those finished cartridges which have, accidentally or otherwise, a deficient powder-charge. (Fig. 5.) It is composed of a vertical wheel with grooves in its rim, parallel to its axis of revolution. A cartridge is placed in each groove, as the groove comes uppermost, and is carried around by the wheel until it rests upon a delicately-poised lever. If the cartridge is too light, the lever does not move, but the cartridge falls on one side of an inclined valve at its end. If it have the requisite weight, the lever falls, the valve opens in another direction, and the cartridge falls into a separate compartment.

The lubricant of the .60-caliber bullet is composed of beeswax and tallow, inclosed in the cannelures of the bullet, which has a cavity and expanding cup of the original Minie pattern. The first operation in making bullets is to convert the pig-lead into lead wire.

The .42-caliber bullets are patched with thin strong paper, and lubricated with a substance composed principally of stearine, which is contained in a paper cup, forming a wad, lying between the powder and bullet. Specimens of cartridges were kindly given to us. The quality of the manufacture of all cartridges is tested by frequent firings.

The arsenal where bronze guns are cast, turned, and bored, and wrought field-carriages of every description made, was next visited.

The main building, which includes the boring and turning mills, is built in a very substantial manner, the walls and roof being thick and made of brick. The central room has a very high ceiling, and runs the length of the building; the other rooms are parallel and on each side of it, as shown in the drawing, (Fig. 6,) which represents a section of the building. In each side room there is an over-head railway, which supports a heavy hoisting-machine, capable of lifting and carrying cannon or other work to any of the machines for boring, turning, planing, &c., within the room.

The body of the new pattern field-gun carriage is made of plate-iron, with two flasks or cheeks, on the Gribeauval plan. (Fig. 7.) A plate of iron is cut to the desired shape of the cheek, leaving notches for the trunnion-beds and axle-tree. To the edge of this plate is riveted angle-iron to give it stiffness. Special plates of iron of considerable thickness are riveted around the trunnion-beds and axle-body. The cheeks are joined together by plate-iron and rivetn

The hand-spikes are of wood, and two i number. They are hinged to the trail, and when not in use are thrown forward and rest between the cheeks.

The wheels and limber-body are of wood. The pintle is placed some distance in rear of the ammunition-chest, thereby counterpoising the pole and permitting the carriage to be turned in a short space. The pole is, in consequence of being supported, heavier and stronger than those in the United States service.

Specimens of iron nave-boxes were observed. Carts drawn by three horses abreast are used for carrying the ammunition, and to take the place of the ordinary caisson. The shaft-horse is ridden by the driver, and the other two horses pull at his right side; arrangement is made for pulling on the left side in case it may be necessary to increase the number of draught-horses.

The Russian field-carriage was formerly constructed to allow the gun to be traversed through a small arc without moving the trail. This arrangement has been dispensed with and the cheeks made solid. The trunnion-beds are placed sufficiently above the axle-tree to allow the piece to be elevated 22°. To avoid a very long elevating-screw for this purpose the screw is made compound, or with one screw working within the other. (See accompanying sketch, Fig. 8.)

The four establishments visited this day are under the separate control of officers of artillery designated as superintendents. The superintendent of the arsenal is a general in rank; the others are captains, with a salary of 3,000 roubles each, which is greater than their regular salary. Each room or workshop is under the special supervision of a second captain or lieutenant, whose duty it is to be present during working-hours and supervise the workmen and inspect the work when finished.

No women are employed in any of the ordnance workshops of the Russian government, but are employed more or less in private shops.

White oak and pine are the principal timbers used in the construction of artillery-carriages, the former for wheels and other parts requiring strength, the latter for the sides of ammunition-wagons, &c.

About 1,000,000 of old muzzle-loading muskets of .60 caliber have been altered to breech-loaders on the system of Krnka, and the main body of the army is armed with them. In this system the breech is closed with a *block* or *gate* pivoted to the left side of the breech, and in opening swings to the left after the manner of the Snyder breech-block. This breech-block is locked in place by the hammer, which rests on the head of the firing-pin. The receiver or frame in which the breech-block works is made of bronze and screwed on to the barrel. The extractor is placed on the left side of the breech, and is operated by the breech-block as it is thrown open. (See notes on small arms, appended.)

The Russian sharpshooters are armed with the .42-caliber Berdan rifles, two patterns of which are in the Russian service, one with a swinging breech-block, made by the Colts' Patent Fire-Arms Co., Hartford, Conn., and the other a bolt-gun made in Birmingham, England. It is understood that the latter form of gun has been adopted for the entire army.

Visited the artillery-firing ground near the city of St. Petersburg, August 1, 1873, at Wolkowa. The ground is in the immediate suburbs of the city; it is low and level, and appears to extend many miles. The buildings occupied by the artillery soldiers on duty as laborers, &c., conducting firings, mounting guns, &c., are of wood, and of temporary construction.

An 8-inch rifle-gun, reamed up to a 9-inch bore, was being tested in the navy department of the ground, and we were kindly invited to witness the firings.

The target was 4,300 feet distant, 14 feet high and 40 feet long, and made of boards. It had been somewhat reduced in size by the shots striking it.

The two shots which we observed through a telescope in the observatory tower, appeared to strike within 2 feet of each other, about 6 feet below and 2 feet to the left of the bull's eye. Subsequent shots which we did not witness through the glass, or from the tower, appeared to pass over, and some of them below the target. The sound of the projectiles moving through the air was smooth. The weight of the projectile was 270 pounds, and the powder 23 pounds, (Rodman prismatic.) There were several miss-fires—the primers had been condemned as defective.

A large number of men—some thirty or forty—were employed in dismounting and mounting an ordinary siege gun.

Examined some 11-inch projectiles which had been fired, and found the marks of the grooves on them well defined.

A building, some 100 yards distant from the batteries, was used as an office by the "committee on experiments." It is here that velocities are taken, principally by the Boulanger chronograph. There were other machines for obtaining velocities, as Navez-Leurs, and Desbrettes, but Boulanger's appears to be exclusively used at present.

Specimens of copper for taking pressures with a Rodman pressure-gauge were also observed.

We next examined a new 6-inch breech-loading rifle-mortar mounted on its carriage ready for firing. (Fig. 12.) The cheeks are formed of single pieces of boiler-plate 1 inch thick. To the lower edge of the plate is attached a shoe formed of a flat bar and two pieces of angle-iron, thus:

At each end, or near each end, is a piece of angle-iron riveted to the shoe to guide the carriage on the chassis, thus:

The piece is elevated and depressed by a circular rack worked by a pinion. The rack is attached to the lower side of the piece and in front of the trunnions, and the pinion is attached to a shaft which extends horizontally through the cheeks and at right angles to them. This shaft is turned by a crank at each end, and on the left end there is in addition a clamp-nut to hold the piece at any desired elevation. By this apparatus the piece is quickly brought from the firing to the loading position, and *vice versa*. The cheeks are held together by assembling bolts; to keep them at the proper distance from each other, the bolts pass through pipes cut to a length equal to this distance.

The chassis lies directly on the platform, composed of planks, and consists of two sticks of timber with traverse-wheels at the rear end. The front end is fastened to a pintle inserted into the platform. On the front edge of each cheek is a strap of flat iron bent to form a square hole for an axle-tree. To this axle-tree is attached a pair of traveling wheels for moving the mortar from point to point. The rear end of the carriage is supported by a siege-limber. The axis of the trunnions is about 3 feet 9 inches above the platform, and the extreme length of the carriage is about 8 feet when it rests on the platform.

The charge of the 6-inch mortar is 7 pounds, the weight of the projectile 90 pounds. Prism-powder is used for 8-inch guns and upward; grain-powder is used for all calibers below 8-inch. It is contemplated to make a breech-loading rifle-mortar with a bore as large as 11 inches diameter.

There were a large number of 24-pounder cast-iron breech-loaders on the ground. We were informed that it was intended to band these guns with steel rings.

A bronze 9-pounder was pointed out that had been fired 2,000 times with service-charges, and many additional times with higher charges. An examination of the bore showed but little wear or injury, although several shrapnel had burst in it. This exemption from injury must be mainly attributed to the snug fit of the lead-coated projectiles used in the gun.

A short 24-pounder breech-loading cast-iron gun was being fired for endurance. It was loaded and fired with great ease and rapidity.

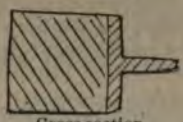
In loading the 9-inch navy-gun the chamber was cleaned with a sponge made of bristles dipped in glue and inserted in holes about $\frac{1}{4}$ inch diameter bored into a cylinder of wood.

For field-service each projectile is packed in a separate compartment in the ammunition-cart, resting on a bed of tow. Before putting the projectile into the compartment, a cap of papier-maché is put on the point to cover the fuse; the bottom of the projectile rests on a circular disk of lime solidified in a cotton-cloth cup, and all are bound together with spun yarn. (Fig. 13.) Some ammunition-carts thus packed were shown, which had traveled safely for long distances.

The construction of the Russian siege-carriage is similar to the field-carriage before described, with the exception that the former has the usual traveling trunnion-beds. (Fig. 14.) One peculiarity of both siege

and field carriages is the great height of the trunnions above the axle-tree to get high angles of fire.

The field axle-tree is very light, but is stiffened by a piece of T-iron placed in front, thus:



Cross-section.

No solid rifle-projectiles are employed in the Russian service. A broken shell with a chilled point was examined, and although made of cast-iron, its fracture had the appearance of steel.

August 2, 1873. Visited the artillery laboratory near St. Petersburg.

The buildings are nearly all of brick, and one story high. The walls are very thick and support the groined masonry arches of the roof.

The several buildings in which cartridges are loaded, fuses, &c., driven, and fire-works dried, are isolated from each other, and each building is nearly surrounded with a broad trench filled with water. (Fig. 15.)

The building in the left of the sketch is used as a dry-house for stars and other compositions; these are placed in recesses or pigeon-holes formed of glazed or porcelain tiles, and the heat which passes around the tiles comes from a stove in an adjoining room.

In the building on the right, cartridge-bags of raw silk were being filled with prism-powder for heavy guns. (Fig. 16½.)

Some 4 and 9 pounder shells of new construction (Fig. 16) were also being filled with bursting charges. Their peculiarity consists in making the sides or walls of the shells thin at the base of the point, (or at *a a*,) so that the point shall be thrown forward in the explosion with nearly the weight and force of a round shot. This fragment from the 4-pounder rifle weighs about 6 pounds, and that from the 9-pounder weighs about 12 pounds.

Percussion fuses for experimental use are made of pewter, for cheapness; service fuses are made of brass. Fig. 17 shows the construction of pewter percussion fuses, which were being made at the time of our visit.

The safety-pin *h* is to prevent the plunger from striking *accidentally* against the percussion-powder, and for this purpose the pin is held in place by a wire, which wire is ruptured by a weight attached to it, when the gun is fired. The centrifugal force generated by the rifle motion throws the pin out, leaving the percussion-powder exposed to the action of the plunger. The plunger is filled with grain-powder, and the bottom of the plug is closed by a disk of metal held in place by crowding the metal of the body upon it.

The precise nature of the percussion-powder was not ascertained.

The time fuses which were shown to us were similar to those used in the Prussian service.

A large lot of ornamental fire-works was being prepared for the "name day" of the Empress. The designs were shown in colored chalk drawings on black paper.

The buildings of the laboratory are arranged in a rectangle, and are about 100 feet apart. The dangerous operations are carried on in more distant buildings.

The greatest precautions seem to be taken against accidents, and it is said that they are of seldom occurrence.

Rockets are driven separately in small rooms made for the special purpose.

Spontaneous combustion from colored fires, it is said, does not occur, owing probably to the great care taken in drying them.

The museum has a very complete and neatly arranged set of patterns of all the ornamental fire-works which have been made here, as well as all the tools and instruments used in the various operations of the laboratory.

The French *densimetre à mercure* is employed to obtain the specific gravity of gunpowder.

From the artillery laboratory the board proceeded to the powder-mills at Ochta, some eight miles from St. Petersburg. This establishment is quite extensive, covering upward of a square mile of ground. A small stream of water runs through the grounds and furnishes a portion of the power for the machinery; the balance is supplied by steam-engines. Much attention has been paid to beautifying the grounds, by forming small lakes, laying out walks and roads, and cultivating trees and shrubbery. It has also a very neat church, and a shrine with burning candles; the latter is a common appendage to nearly all the workshops visited. There are numerous soldiers stationed here to guard the mills, and a number of commissioned officers to supervise the various departments of manufacture. The workmen are hired by the day and their number is about 800.

On account of the severe cold these mills are only run seven months of the year, or from April 1 to November 1. The mills in the south of Russia are kept in operation the year round. The amount of powder made during the seven months in the mills of Ochta is 3,200,000 pounds. By the introduction of steam in place of the horse-power now used to grind charcoal, it is expected that this amount will be increased to 3,600,000 pounds.

Great care is taken to prevent accidents, by the strict observance of excellent rules. Only one serious accident had occurred, and that was some ten years ago.

When powder is transported a distance in wagons, the train is preceded, followed, and flanked by an escort of troops. A train of this description was met coming into the city from the mills. No one is allowed to smoke in the road as the train passes.

The formula used for mixing the gunpowder used in the Russian service is 75 niter + 10 sulphur + 15 charcoal.

The charcoal is made from birch-wood split into sticks some 2 or 3 inches in thickness, the original sticks being round and some 4 or 5 inches diameter. It is distilled in iron retorts, after the Prussian or Spandau plan. The heat of distillation is said to be high, and the wood is exposed to it some eight hours, forming what is known as black charcoal. The first operation is to crush the charcoal under iron wheels rolling in a circular trough by horse or steam power. The charcoal thus pulverized is then mixed with its proper proportion of sulphur, and rolled in barrels with brass balls until the whole mass is reduced to dust and thoroughly mixed. After this operation the mixture is taken to the mixing-house proper, and there again mixed by hand with the proportion of niter given in the foregoing formula. To this end 60 pounds of niter is weighed out into a copper pail and put into a wooden trough covered with cloth; after this 20 pounds of the sulphur-charcoal composition is added to it. Through a pipe in the top of the cloth cover 7 pounds of water is poured in, and the whole is mixed or kneaded by hand, the workmen putting both arms for the purpose through two holes

in the cover. The mixture thus prepared is then taken to the rolling or wheel mills, to be incorporated. Altogether there are thirty-two rolling-mills in this establishment, each mill containing a single set of two wheels. The wheels are generally made of bronze, and weigh 300 *pouds* or 12,000 pounds each, and run in a cast-iron trough of circular shape in plan. These wheels are not solid, as in our mills, but are cast with spokes. A charge of 120 pounds of composition is run four hours.

Attention was called to one set of cast-iron wheels which had been running for some time, and, as no more accidents had occurred with them than with bronze wheels, it was understood that all wheels hereafter would be made of cast iron, as elsewhere. To cover a greater amount of composition, one wheel or roller is placed at a greater distance from the center of motion than the other.

The buildings, or mills, are built of brick on three sides; the front and top are of light wood construction, and in case of accidental explosion are blown off, leaving the brick sides standing.

The water-wheel is of peculiar construction, and was invented by an officer of the Russian army for this special purpose—the propulsion of powder-mill wheels. It is composed of two circular rims, (Fig. 18,) between which are fixed curved buckets, which receive the water from an iron pipe opening at the inner rim. The water escapes at the outer rim. The water-wheel is attached by means of spokes directly to a strong iron shaft which communicates motion by bevel gear to the vertical shafts, around which the rollers travel to incorporate the powder. One water-wheel and shaft moves two sets of rollers, as will be seen by reference to the figure. A valve near the mouth of the outlet pipe regulates the supply of water and consequently the speed of the wheel. This valve is worked from the mills by a shaft with suitable gearing.

The incorporated mixture is compressed into cake in two ways, viz: 1st, by hydrostatic pressure; 2d, by passing the mixture between two heavy iron rolls, and for this purpose it is spread to a uniform thickness on an endless band of cloth. This is known as the Prussian method. The compressed composition, or cake, is broken up into grains by placing it in sieves which contain a certain number of bronze balls. Several of these sieves are attached to a horizontal frame, which is supported on wooden arms, (Fig. 19.) The vibration of these arms communicates a back and forward motion to the sieves and balls, crushing the cake into small pieces or grains, which fall through the bottom of the sieves into drawers beneath. The grains are afterward dusted, glazed, and assorted. Dusting is an operation done in revolving barrels of large size. The operation of glazing is performed in cloth tubes arranged in rows and worked up and down by rods attached to a working-beam, set in motion by a crank, (Fig. 20.) The mouths of the tubes are attached to the sides of the case, and the powder is put in and taken out through the openings, which are kept closed during the working of the machine. By the motion of the tubes the grains of powder are glazed by rolling over each other, and the fine particles are sifted through the interstices of the cloth.

Prism-powder is made at this establishment in presses of peculiar construction. The form of the prisms is given in Fig. 16½. (See notes on the "Artillery Laboratory.") The principal parts of the press are: 1st, a hopper, *f*, (Fig. 21,) to contain the grain-powder from which the prisms are made; 2d, a slide for transferring a charge of this grain-powder to the die, which it does by receiving the charge in the hole of the slide *e* and depositing it in the die when the hole is directly over the die; 3d, the piece of metal in which the die is formed is made of bronze, and the

cavity of the die is just sufficient to hold the charge of powder in the loose state; 4th, the punch, which compresses the powder, giving it the requisite density. Inside of the punch *b* are placed seven wires, *c c*, to form the seven holes of the prism. These wires are made of steel and arranged to move independently of the punch. After the punch has completed the pressure it rises, and with it the punch *b*, carrying on its point the prism, which, as soon as it is clear of the die, is pushed on to the inclined plane *h*, by which it descends to the receptacle. The punches as well as the die are understood to be made of bronze. The relative motions of the several parts to accomplish the object of the press are regulated by suitable cranks and cams. The powder employed in this process is taken directly from the graining-mills.

There are ten presses in each building, and each press is attended by one man. Each press has six sets of punches, and makes three revolutions per minute, turning out 18 prisms per minute.

The cost of prism-powder made at these mills is 13 roubles per *poud* of 40 pounds, or about 22 cents per pound.

The only operation to be performed after the prisms come from the press is that of drying. This is done in two ways: first, in an artificial dry-house, heated with steam and hot air; second, in a building with open windows.

Fig. 22 shows the arrangement in plan of a dry-house of the first kind. The buildings and galleries are made of brick.

The central building *b* contains two boilers and two steam-blowing engines. The boilers supply heat for the air which is forced through the galleries *c c* into the two buildings *a a* in which the prisms are spread out on shelves. Heat is communicated to the air from coils of steam-pipe placed in the entrances of the galleries. The time required to properly dry a lot of prisms in this way is one month. The buildings for drying in the natural way are made of wood, and the time required in drying is five weeks.

The materials in the various stages of manufacture are transported from one building to another on wooden railways, on wooden wheelbarrows bound with bronze, and in barrels covered with cloth and suspended from a pole borne on the shoulders of two men. Thick cloths are spread on the floors in all buildings where the operations performed are dangerous, and the workmen are either barefooted or wear felt shoes, in which the soles and sides are about half an inch thick.

Some fifteen mills in one row are propelled by a single turbine-wheel. The power is communicated by a wire-rope three-fourths of an inch in diameter. The mills are about 130 yards apart, and the whole distance to which the power of the wheel is transmitted is upwards of one mile. The same rope is found to last about two and a half years, but as the mills are only run seven months in the year the actual wear of a rope is only about eighteen months.

In one mill the French mode of graining was observed in operation. This consists in rotating horizontally a quantity of the cake in a circular sieve along with a disk or lense of hard wood some 6 inches in diameter and from 1 to 2 inches thick in the center.

The Russian government foundry (or "Aboukoffsky steel-works") for the manufacture of heavy steel guns is at Alexandrovsky, on the left bank of the Neva, and about 10 miles from, and above the center of the city of St. Petersburg. It belongs to the department of marine, and is commanded by a captain of the navy, who very kindly conducted us in person through the different shops and explained the operations carried on in them.

The establishment is complete in all its appointments for making cannon of the largest caliber. The material and mode of construction are similar to Krupp's, or, in other words, the material is cast steel of "low" quality, and the body of the piece is strengthened by layers of steel rings shrunk on the re-enforce. The material from which the steel is made is charcoal-iron brought from the Ural Mountains.

The fuel used for converting the iron into steel is English coal made into coke; but preparations are nearly completed, by the introduction of "Siemens generators," to use for this purpose peat and wood, which are cheap and abundant in Russia.

The crucibles in which the steel is made are formed of materials found in the country. They are capable of containing 70 pounds of iron each, and are arranged in groups of four in furnaces built under the ground-floor of the building. Fires are made around the crucibles from galleries underneath the floor. After the contents of the crucibles have been exposed to the heat sufficiently long to convert them into steel, they are poured into troughs lined with clay. These troughs lead to a reservoir, and from this reservoir another trough conducts the melted steel to a cast-iron mold situated in a pit. When the heated mass or ingot, as it is called, has contracted sufficiently by cooling, it is withdrawn from the mold and transferred to another building to be hammered to give it density and shape for turning and finishing.

The largest steam-hammer at this establishment weighs 50 tons, and acts by falling through a height of 12 feet. The weight of the cast-iron anvil-block is 500 tons, (made in two pieces of 120 and 380 tons, respectively.) The depth of the foundation is 70 feet, composed of 50 feet of concrete at the bottom and 20 feet at the top of timber to absorb the shocks of the hammer on the anvil. A "Siemens furnace" for heating the ingot stands near the hammer. That the ingot may be put in and taken out readily, the bottom of the furnace upon which the ingot lies (and which is made of fire-brick) runs in and out on a railway. The heated ingot is lifted to the hammer by a powerful crane, and is manipulated by a porte-bar in the usual way. The "generators" are placed at considerable distances from all the "Siemens furnaces," leaving a greater space for working at the hammer.

The steel made at this foundery for cannon is tempered in oil, after the Woolwich arsenal process.

The largest rifle-gun made here as yet is one of 12-inch caliber for experimental purposes. Breech-loading guns of 9 and 11 inch caliber, closely resembling Krupp's, are the regular products of the establishment. The total length of the 11-inch gun is 20 feet. In general terms, the twist of the rifling of Russian guns of all calibers is one turn in four times the length of the bore proper. The transverse hole for the breech-piece is first bored out round and then slotted to the desired cylinder-prismatic shape. The cutting-tool is attached to a rod supported horizontally on a carriage, which is moved by a rack and pinion, as shown in Fig. 23.

The heavy guns are moved from point to point in the finishing-room and taken out and put into the lathes, &c., by means of an overhead-crane capable of lifting 60 tons. This crane is composed of a movable railway made of two boiler-plate girders, (Fig. 4,) on which runs a lifting-machine, consisting of a windlass, a stout chain, and the fall. The windlass is turned by a crank connecting with suitable gear. The rails on which the girders move are supported by two rows of columns extending lengthwise of the building. The power which moves the girders is communicated from the main shaft by a wire rope. There is

wrought iron. The wheel-tire is made of a single flat bar bent into the circular form. The felloe is formed of a bar of T-iron also bent into a circular form and placed within the tire and riveted to it. The spokes are round rods inserted diagonally into cast-iron hubs and joined to the web of the T-iron or felloe by bolts or rivets.

Specimens of the steel from each gun are carefully tested for strength by one of Kirkaldy's machines. The specimens are in the form of cylinders, about one-half inch in diameter and some 8 or 10 inches long.

A very ingenious instrument is used for measuring the diameter of the specimens, the peculiarity of which is an arrangement to prevent the measuring points from indentating the specimens and giving erroneous measurements.

Steel barrels for small-arms are made and finished at this establishment.

PRUSSIA.

The establishments at Spandau, Prussia, which were visited on the 10th of August, were the bronze cannon and projectile foundry, the carriage and leather workshops, the powder-mills, and the infantry or small-arms firing-ground.

Bronze gun and projectile foundry.

The buildings and machinery of the gun and projectile foundry are new and of the most approved kinds. Field and siege cannon are here made of bronze up to 24-centimeter or 9.5-inch caliber.

The manner of preparing the molds for casting bronze guns is, first, to make a model of the gun in sand; thin layers of clay, quite wet, are then spread over the surface of the model, at the same time cord or wire is wrapped around the layers of moist clay; after drying, the sand is removed, leaving a mold or matrix of the gun. The cord or wire gives strength to the body of clay surrounding the mold to resist the pressure of the melted metal. Before introducing the melted metal, a round bar of iron, having a diameter a little less than that of the bore of the gun, is fixed in the center of the mold as a nucleus around which the gun is cast. This iron is afterward entirely cut away in forming the bore. The density and toughness of the bronze are found to be increased by contact with the iron core in the mold, and probably for this reason it is so employed in this case.

A large number of captured bronze guns were lying on skids in the yard and furnish a large proportion of the material used in this work.

Rifling is done by repeatedly forcing the cutter-rod into the bore with a screw. Six grooves are cut at the same time. The bore and grooves are afterward smoothed out with a close-fitting cylinder, with projections for the grooves, covered with oil and emery flour. The cylinder is drawn through from one end to the other of the bore with a chain worked by a windlass.

The system of breech-loading, including the copper gas-checks, is very similar to that of the Russian bronze guns.

The machine for testing the strength of specimens of the metals used in this foundry is constructed on the lever principle. It is worked by hydraulic power; is capable of exerting a force of 300,000 pounds, and is arranged to exert a force of compression as well as one of extension.

This machine was made in Berlin in 1856, and is much more compact than Kirkaldy's machine, which was noticed at the Russian cannon foundry.

Officers were engaged in making careful inspections of a large number of cannon breech-blocks, arranged on a cast-iron table, having its surface planed smooth for accurate measurements.

The slotting-machines, employed for cutting the transverse-hole in the gun for the breech-piece, have two cutters attached to the rod-rest instead of one, as in the Russian foundry.

Projectiles, at this foundry, are cast in sand-molds contained in iron boxes or flasks; before pouring the melted metal into the molds they are firmly bound with iron clamps.

The regular-service projectiles have lead coatings, which are at first cast on quite thick, but afterward turned off in a lathe, leaving the usual projecting bands. The iron surface of the projectile is cast smooth, and then dipped in a solution of sal-ammoniac; after this, it is immersed in a bath of melted zinc, and at the same time revolved on its long axis by means of an iron rod inserted in the fuse-hole. During this revolution, which is done by one workman, another presses a mass of sal-ammoniac, fastened to the end of an iron rod, on the surface of the projectile. After a sufficient amount of zinc is made in this way to adhere to the surface, the projectile is placed in an iron mold and the lead coating cast on it.

In the projectile department some shells were being prepared with copper bands in place of the lead coating, in the manner shown in Fig. 28. The grooves in the projectile, in which the bands are inserted, are cut under in the dove-tail form, and the under side of the copper is grooved to permit it to be easily forced into and take a firm hold of the under-cut portion of the grooves. The officer in charge stated that the results obtained with these experimental copper bands were not so favorable as with the usual form of lead coating.

Breech-loading rifle-mortars of 24-centimeter bore were employed with good results in the late French and German war.

Experimental shells were in process of trial in which the interior surface was deeply furrowed to facilitate the breaking up of the metal into numerous fragments of somewhat regular shape.

The usual overhead cranes, worked by wire ropes, are employed in this establishment for handling guns and other heavy work.

The carriage-factory adjoins the bronze-cannon foundry. The smiths' and carpenters' shops are but one story high. The roof is of the saw-tooth pattern, as shown in Fig. 29. This arrangement of shop-room is found very convenient for carrying on work and for the supervision of the workmen, but it is doubtful if it can be applied with comfort to the workmen in a climate as variable as ours. Carriages of every description and for all branches of the military service, quartermaster, medical, &c., are made here. The principal carriages, however, in hand, were for the 15-centimeter siege-gun, some of which were made partly of wood and partly of iron, and others entirely of iron.

The powder-mills of Spandau are about one mile from the city, and adjoining the new manufactory of the "Mauser rifle," lately adopted for the Prussian army.

The grounds of the powder-mills are quite extensive, and intersected with numerous canals which supply power to the mills through under-shot water-wheels. A large portion of the grounds is covered with trees, and the roads from one mill to another are lined with them, forming picturesque avenues.

The buildings are mostly of the prevailing style of the country, viz, a frame-work of wood filled in with brick. The doors are sheltered by porches. Whenever the work done is of a dangerous character the building is surrounded on three sides with high mounds of earth to confine the effect of accidental explosions.

Owing to the exercise of great care and the peculiar mode of manufacture pursued here, accidents but rarely happen. Within the last forty-one years, it is stated, but two explosions have occurred, and only in the latter one was there loss of life. The explosion herein referred to occurred in a mixing-mill soon after the introduction of brown charcoal for the manufacture of a special powder for the Mauser rifle.

Across the river were seen the tall chimneys of the private military laboratory, into which visitors are not admitted.

The charcoal employed for powder at Spandau is made from the wood of the willow and a species of alder. The sticks, which are not much over an inch in diameter, are stripped of their bark when piled up for seasoning. The process of charring is that by distillation, and for this purpose the sticks are placed in cylindrical retorts of iron about 2 feet in diameter and about 4 feet long, after which the retorts are put into ovens, the mouths of which are tightly closed with iron covers.

To make brown charcoal, the retorts are heated for three hours; for black charcoal, four hours. The inflammable gases which pass off from the wood to the receptacle for the tar are returned in a pipe to the fire and burned underneath the retorts as they escape through a slit in the pipe. In this way a saving is made in the coal and peat employed in the process of distillation.

Formerly black charcoal was employed in Prussia for all kinds of military powder; now it is confined to cannon-powder, and brown coal is used in the manufacture of rifle-powder.

The charcoal is pulverized in a rolling barrel with balls.

To pulverize the sulphur, it is first melted and poured into large pots to crystallize it and render it friable; it is then mixed with a small proportion of niter and rolled in barrels. The mixture is known as sulphur-saltpeter.

All the ingredients of the powder are then mixed in the proportions of 64 saltpeter, 20 sulphur-saltpeter, and 16 charcoal, and rolled in barrels with a large proportional amount of bronze balls one-fourth inch diameter. It was in this operation that the accident referred to occurred, caused, as supposed, by the use of brown charcoal.

After the composition has been throughly mixed, it is compressed into cake by passing it between two rolls on an endless band of cloth. The rolls are about 18 inches in diameter, and revolve once in 12 minutes. The cake thus formed is broken into grains by revolving it horizontally in a circular box with a disk of wood. This is known as the "French process" of graining powder. After being dried on shelves exposed to the air, the grains are sent back to the mixing-mill and worked over, as previously described. The grains are glazed and dusted in revolving barrels, and after this dried on tables under which are placed steam-pipes.

The barrels for packing the powder resemble those of the United States service in the size and materials of which they are made.

In all the mills the floors are covered with thick cloths, and the workmen either wear no shoes at all or shoes made of very thick felt.

About 1,800,000 pounds of powder of all kinds is annually made at these mills.

The density of the powder is 1.6 The grain for field-service appears to be rather larger than our No. 5, or "cannon" powder. The machinery for making prism-powder was not shown, but we were informed that it is the same as that employed in the mills near St. Petersburg.

Firing-grounds.

The target-practice grounds for infantry and cavalry are about one mile from the town of Spandau, and in a pine forest of young growth. Avenues, nearly parallel to each other and terminating in a high bluff, are cut through this forest and afford the required ranges up to 1,600 meters. A system of electric telegraphs communicates with the targets and other important parts of the establishment. Along one of the avenues is a row of high poles for the purpose of determining trajectories by the aid of paper screens.

Traverses of earth are thrown up at suitable intervals along the ranges for the protection of the markers. The marker generally leaves the shelter to patch the target; in one instance, however, a railway was noticed for withdrawing the target behind the traverse to patch it.

The targets are composed of a wooden frame covered with paper. The smallest size noticed was 4 feet wide and 6 feet high. Other targets were noticed with figures of soldiers on them, both mounted and dismounted. The firing is all "off-hand." One non-commissioned officer and two men are detailed from each regiment for a service of six months at this particular school.

On the 12th of August the commission visited the artillery-firing ground at Tegel, in company with Colonel Bliss, secretary of the American legation. The minister of marine and a number of officers of the army and navy were present to witness certain experiments with an iron-plated target. The target was composed of two 4½-inch iron plates, (one above the other,) made by Cammel & Co., England, and backed with 18 inches of oak. (Fig. 32.) The guns fired against this target were of 12, 15, and 26 centimeters caliber, respectively. The projectiles were of steel and chilled cast iron, the latter made by Mr. Gruson, of Magdeburg, who was present at the trial.

The 12-centimeter chilled shell was completely broken up in the target. The steel shell was not broken, but was distorted. Neither penetrated through the 4½-inch plate.

The 15-centimeter shells penetrated into the wooden backing, and some fragments from the one which contained powder (the live shell) were thrown to the rear of the target. The charge for propelling these shells was 12 pounds of prism-powder. The shells weighed 64 pounds each.

To ascertain if a thin 26-centimeter chilled shell would penetrate through the plate, one was fired against it with and another without a bursting-charge. In each instance a hole was made completely through the target. In the first, in which the shell was loaded, it appeared to burst in the iron plate, leaving a clean hole through it 42 centimeters in diameter. In the second instance an unloaded shell broke in the wooden backing, and left a smaller hole than the first shell.

The usual hydraulic buffer was employed on the carriages to take up the recoil, in which glycerine, however, takes the place of water, as it does not freeze in cold weather.

The arrangement for returning the gun to battery is the same as that used on Krupp's carriages, *i. e.*, a supplementary inclined plane fastened to the upper surface of the chassis-rail behind the gun-carriage. The

traverse-wheels are grooved and run on raised circles. (Fig. 33.) In this way they take up nearly all the strain that usually comes on the pintle.

The power for traversing is applied through a windlass and chain on the plan of Cunningham. The gun is elevated and depressed by means of a circular arc and pinion.

A target was examined which had been employed in some previous experiments. The upper section was composed of 9-inch wrought-iron plates; the middle section of 10-inch plates; the backing was 18 inches of oak, and the "inner skin" was 1 inch thick.

The lower or 12-inch plates had been completely perforated by an 11-inch chilled blind shell. The judgment of the officers who conducted these experiments was understood to be in favor of the superiority of chilled cast iron over steel for projectiles against iron plates.

The experiments made at this place with the narrow copper bands, à la Vavasseur, before referred to, for projectiles in place of the lead coating, do not favor their adoption.

To prevent the lead coating from stripping with high charges, it is proposed to harden it by a slight admixture of tin or antimony. The lead coating of the 26-centimeter shell which burst to-day in the backing of the 4½-inch target was so prepared.

We were informed that it was proposed to reduce the number of raised bands on the lead coating of all projectiles of the Prussian service to four, as shown in Fig. 34. The front band *a* is smaller in diameter than the others. Next larger is the band *b*; next to this is the band *c*; and largest in diameter of all is the rear band *d*.

A hydraulic crane is employed to raise heavy guns and transport them to and from the firing-ground. It consists of two hydraulic cylinders mounted on four wheels each, which have flanges to run on a railroad-track. The two pistons support the ends of a compound iron beam on which run two carriages supporting strong hooks, and to which the chains enveloping the gun are attached. The beam is raised and lowered by pumping into or letting out the water from the cylinder. A side and end view of this crane are given in Fig. 35.

Velocities of projectiles are taken by two Boulanger chronographs in a small building several hundred yards distant from the firing-battery. The first pair of targets for obtaining initial velocities is placed about 25 feet in front of the battery, (Fig. 36). The second pair is placed generally 100 feet from the first. The targets in each pair are 10 feet apart. The wires on the targets are very small in diameter. Those leading from the targets to the chronographs are larger and covered with an insulator, and when not in use are wound around reels similar to an ordinary hose-cart.

The 15-centimeter (6-inch) Prussian gun has an initial velocity of about 1,470 feet. The initial velocity of the 11-inch gun is about 1,390 feet, with corresponding internal pressure of 2,400 atmospheres.

The distance of the targets from the guns, in the trials for penetration herein referred to, was 150 meters. The trial-shots at the wooden target to adjust the sights were nearly coincident.

Two men can traverse the 10-inch Prussian gun mounted on the navy-carriage; four men can perform this operation easily. The traverse-wheels have the usual holes in the rims for handspikes to be used in case of accident to the geared traversing apparatus.

The chassis-rail of the carriage is very heavy, and built up as shown in the sketch. (Fig. 30.)

A muzzle-pivoting carriage, built by Mr. Gruson, was also examined. The cheeks are very high and joined together at the top by iron bows or arches. The gun is raised and lowered by water or hydraulic power placed on the cheeks so as to act indirectly on the trunnions. This carriage is said to answer its purpose well.

Tegel is about four miles from the city of Berlin. Space for the firing-ground has been formed by clearing away a pine forest for a distance of two miles. The workshops and other buildings are large and substantially built, and whenever necessary are protected by the usual high traverses of earth. It was understood that new firing-grounds had been selected farther from the city, where greater ranges will be obtained.

At the arsenal in Berlin, were seen a very fine collection of ancient and modern arms of all kinds. Among other specimens are several machine-guns (mitrailleuse,) one of which was made in 1604.

A very simple siege-limber was observed, made principally of a single piece of angle-iron bent into the shape shown in Fig. 37; all parts are of iron except the pole.

Visited Krupp's steel-manufactory at Essen on the 14th of August. Limited time prevented us from examining this vast establishment fully, and our observations were confined chiefly to the cannon departments.

The steel-melting room is of great size. The furnaces for heating the crucibles are built under the floor, and communication is by subterranean galleries, in which the firemen apply the fuel. Each furnace contains four crucibles, and each crucible is capable of holding and melting 70 pounds of iron while being converted into steel.

The ingot of steel is formed by pouring the contents of the crucibles, one after another, into a cast-iron mold in a pit; when the mass has cooled and contracted sufficiently, the mold is lifted off the ingot, and as soon as it has sufficiently cooled to be handled it is transferred to the hammer-room to be forged into the required rough shape. A continuous stream from the crucibles into the mold is necessary to secure uniformity of texture in the ingot.

The largest ingot ever made at this establishment weighs 50 tons, and is the single product of 1,800 crucibles. This ingot was transported to Vienna and placed on exhibition in Mr. Krupp's department of the "world's fair." When it is returned to Essen, it is to be hammered and finished for the body of a gun.

At present the largest steam-hammer at this establishment weighs 50 tons and has a fall of 12 feet. A hammer of 150 tons with a fall of 15 feet has been projected, and we were informed would soon be put up for the manufacture of guns of any size demanded by the progress of the art of gun-making.

A 14-inch or 1,000-pounder rifle-cannon was mounted on its carriage in one of the shops. This gun is the same or similar to the one placed by Mr. Krupp in the Paris exhibition of 1867. It now belongs to the Prussian government, and we were informed that it was soon to be transferred to the fortifications of Kiel.

A large number of 24-pounder steel breech-loading cannon for siege and naval purposes were in course of manufacture in the shops, besides others of larger calibers.

Mr. Duychman, the chief engineer of the works, states that Bessemer steel does not make good guns, owing to its want of uniform texture in the ingot. It is used, however, for rails, which are made here in great numbers.

The cast steel employed here for guns is made of puddle-steel, and is of peculiar character, combining great tensile strength with considerable

elongation or property of stretching before breaking. One department of these works is devoted exclusively to testing specimens of all of the various kinds of steel produced in the establishment. The testing-machine is similar to the Wade testing-machine used in this country, but considerably larger and more powerful. The person making the test is purposely kept ignorant of the object for which the material tested is to be used. A specimen broken in our presence showed considerable elongation, and finally separated under a force of 81,000 pounds per square inch.

The authorities of this establishment firmly believe in the superiority of steel over chilled cast-iron projectiles for penetrating into iron armor.

In rifling heavy guns but one groove is cut at a time, and then as the rod bearing the cutter is pushed through the bore. The cutter is fed out by hand at each cut. A workman injects oil with a syringe into the bore ahead of the cutter; at the same time oil is fed automatically in rear of it.

Attention was called to a new and simple plan for making the cheeks of field-carriages out of a single piece of thin plate steel. The plate is first cut to the general shape of the cheek, but considerably larger; it is then heated and pressed in suitable dies to the shape and size of the required cheek, at the same time forming a flange around the entire edge. This flange gives stiffness to the cheek and affords the necessary surfaces for attaching the trunnion-bed, axle-strap, and lunette. (See Fig. 38.)

A limber to accompany this carriage is shown in Fig. 39.

A field-gun carriage, with a brake to check the velocity of the carriage down hill, was also noticed and is represented in Fig. 40. The bar of the brake is made of iron in the form of a truss to make it light and stiff; it is sometimes made of gas-pipe for the same reasons. It is placed crosswise of the stock and in rear of the piece, and is worked by connecting-rods and a screw in the head of the stock. An examination of the sketch will give a general idea of its arrangement.

The cannon made at Essen are proved in a large underground room, arched with heavy brick masonry. There are large openings in the roof for the escape of smoke, and putting in and taking out the pieces to be proved.

Cannon and other large work are transported from one point to another of the works on cars running on railway-tracks and drawn by locomotives.

A new proving-ground, with a range of some 7,000 meters, is being prepared by Mr. Krupp for further testing the 12-inch gun on exhibition at Vienna, and other cannon.

About six miles from Essen is Bochum, a town containing a cast-steel manufactory, which employs some 6,000 workmen. The principal articles made here are rails, wheels, axles, springs, bells, and field and siege cannon, all of steel. The rails are made of Bessemer steel, and there are seven converters in use; the largest is capable of turning out 7 tons in one charge. The cast steel is made as at Krupp's, with a single exception, viz, the melted steel is not poured directly into the mold, but passes from the crucibles into what is known as the "overheating-furnace," when it is again exposed to heat for a certain time to render the mass more homogeneous, and thereby avoiding spots of weakness. The idea of this furnace originated with Mr. Meyer, the experienced assistant director of the work.

At present the largest steam-hammer here weighs 30 tons. The cranes for handling the mass of steel to be worked were made in Berlin, and are of peculiar construction. (Fig. 41.)

The two cranes are composed of two overhead iron girders, which swing like arms around the center of the steam-hammer as an axis. The outer ends of these girders are sustained by iron props which rest on railway-cars running on a circular track around the hammer. Each car has a small steam-engine, which both works the windlass and winds up the chains sustaining the ingot and propels the car on its circular track. It also works the movable pulley to and from the hammer.

Preparations are being made to erect a 50-ton hammer at these works.

A number of 15-centimeter siege rifle-guns are being made in the cannon department, besides a number of 3-inch and 3½-inch field-guns to complete a contract with the Turkish government for 500 guns. All these guns are of the Krupp pattern, and the quality of the workmanship is excellent.

The crucibles are generally used but once; they are then broken up and ground to powder to furnish materials for new ones. The mode of making crucibles at this establishment is kept a secret.

Witnessed the operation of forging locomotive driving-wheels out of a solid mass of wrought iron. The mass being of round, flat shape, is hammered so as to form on its circumference as many projections as there are to be spokes in the wheel. The projections are afterward drawn out under the hammer and their ends split in two, bent over, and welded together so as to form a continuous felloe. The circumference of the wheel is then carefully turned in a lathe, and a steel tire is shrunk on.

The demand for steel rails in Germany alone is stated to be sufficient to keep these and other large works in full operation. Iron rails are said to last about two and one-half years, whereas those made of Bessemer steel will wear ten years.

The country in and around Essen and Bochum is underlaid with coal, which affords all the fuel required for these and other large iron and steel manufactories in this neighborhood.

Some of the shafts are 500 feet deep, and the seams, which are more or less inclined, have a thickness of 3 feet in some cases.

But a short time ago the Bochum Company bought certain coal-mines for 130,000 thalers. In consequence of the great increase in the iron and steel business these same mines are now considered worth 2,000,000 thalers.

Mr. Bancroft, the American minister at Berlin, informed us that the German government has projected an air-line railroad for military purposes from the Russian frontier at Wierzbolow, to Metz on the French frontier.

AUSTRIA.

Under the guidance of two officers of artillery and two of engineers, an examination was made, August 23, 1873, of the artillery museum in the city of Vienna. This museum contains models of guns, carriages, &c., in service, as well as many of an experimental character.

Noticed a spade with a jointed handle that we were informed had been adopted for the infantry, every third man carrying one. The blade is about the size and shape of those used in the army of the Potomac toward the end of our war, but the handle is jointed so as to fold up when not required for use, and is kept in the folded position by a strap.

A great variety of digging or intrenching tools have been tested for the use of the Austrian infantry, and it was understood that this small spade has been preferred to all others tried.

We were shown the two principal muskets in use in the Austrian army, viz, Wanzl and Werndl. The former is an alteration of the muzzle-loading musket, and in it the breech-block rises and falls like our own. The Werndl musket is new, and has a caliber of 0″.425. In the breech system the block vibrates around an axis parallel to that of the bore. About 500,000 of the new Werndl muskets are in the hands of the troops. A late model of this arm was shown in which the characteristic flat breech-block spring on the outside of the block is concealed in it. The parts of the new arm are interchangeable and more highly finished than in the previous models.

The locks of all small-arms are made in the arsenal in Vienna; the remaining parts are made in private establishments, but assembled and inspected in the arsenal.

The Austrian field-artillery is principally made up of bronze muzzle-loaders. They are rifled on the saw-tooth principle, and the lead coating of the projectile is formed to fit the grooves of the piece. The carriages are made of wood, after the Gribeauval style slightly altered. The ammunition-chests are made of sheet-iron. Apparently little, if any, change has been made in the field-carriages for many years past.

Projectiles, with studs, and bullet-shells with the powder-charge under the bullets, were observed in the museum.

An officer in attendance informed us that the Austrian gunners suffered much in the Italian war from exposure to case-shot firing while loading heavy sea-coast guns, and that, in consequence of this, several experiments had been made with depressing carriages of the Moncrieff pattern. Some of the carriages were completed, but had not been found to work well in practice.

A small model of a very simple muzzle-pivoting carriage was observed. It is shown in the accompanying Fig. 43. The trunnions are supported in the piece *a*, which is pivoted at *b*, while the other end is raised and lowered by the elevating-screw *c*. The flat bars *d d d* are bolted to an upright bar, *e*, forming two cheeks, which rest and slide on a chassis in the ordinary way. The idea involved is a very simple one, and if the parts were made so as to have the necessary strength and a hydraulic jack were used in the place of the screw, the carriage might perhaps be a practical one.

Fig. 44 represents a specimen of a small rifle-mortar in the museum. It is of novel construction, and is said to throw its projectile with considerable range and accuracy. The outer part of the mortar covered by the projectile is a polygonal spiral solid, like a Whitworth projectile. The projectile cavity has a corresponding shape and fits on the mortar like a cap. The action of the powder is to drive off the projectile with a spiral motion. The portion *b* is to give a preponderance to the rear of the trunnions.

Prism-powder similar to the Russian, is employed in Austria in large siege and sea-coast guns.

In the artillery-harness, collars, hames, and rope traces are employed.

The Boulanger chronograph has been adopted for determining velocities of projectiles.

After an examination of the artillery museum, we were shown the apparatus and instruments in the chemical laboratory and the philosophical rooms, used principally in reference to the firing of torpedoes. Experiments were made to show the modes adopted for firing torpedoes: 1st, by contact with the object vessel; and, 2d, by electricity worked from the shore. In the latter case, the spark is made by closing and

then breaking the current, à la Rhumkorf; and in the former case, the sudden contact of any one of the pistons of the torpedo with the hostile vessel will be sufficient to explode it.

The field-telegraph in use is worked by a magnet, and the alphabet is that of the Morse system.

For siege operations at night, electric lights, with large parabolic reflectors, are employed to light up an enemy's works. A specimen of the apparatus was kindly shown and explained.

Visited the Vienna arsenal on the 25th of August. This establishment is situated in the outskirts of the city, is of very great extent, and was built from a single design.

The first point visited was the foundry, where bronze and iron guns are cast. The molding and casting room is of circular form, and the furnaces are ranged radially around one side of it. The gun-pits are of annular form and immediately in front of the furnaces. An iron crane stands in the center, so that its arm can sweep over all the pits, (Fig. 45.) This arrangement of furnaces, pits, and crane, appears to be very convenient, especially for casting cannon of small size.

No particular system of sea-coast and marine cannon, of large size, appears to have been adopted in the Austrian service. A 9-inch trial breech-loading cannon had been tested, in which the breech-loading apparatus was similar to Krupp's, but the body of the piece was made of cast iron, enveloped in steel rings. This gun is said to have endured all the tests, and was only broken at last by a charge of dynamite, that the materials might be more easily transported from the trial-ground to the arsenal. The rifle-grooves of this piece were broad, and the projectile was provided with studs to fit them. Longitudinal furrows in the bore, at the seat of the projectile, were noticed. No report had then been made public of this test, but it was expected that one would be in the following January.

The cast iron of which the large Austrian cannon are made comes from Styria, and bears a very high reputation as a cannon-metal.

All the present field-guns are made of bronze, and muzzle-loading. In loading there is a peculiar arrangement of the rammer for centering the projectile before firing, by which it is claimed that great accuracy of fire is obtained.

Noticed a large number of wagons for transporting infantry-ammunition in the field.

The museum is the finest affair of its kind probably in the world. In the lower entrance-hall are marble statues of distinguished Austrian statesmen and warriors. In the upper halls are collections of arms and armor, both ancient and modern, and on the walls are painted beautiful frescoes illustrating Austrian history.

In the English department of the Vienna Exhibition were noticed several guns, carriages, &c., from the manufactory of Sir William Armstrong, at Elswick, England. The largest piece was a muzzle-loader of 10-inch caliber and 18 tons weight. It was formed of a steel-lined wrought-iron tube strengthened with wrought tubes or rings, giving it the appearance of a Woolwich gun. The agent in charge stated that the cost of guns of this kind was 30 per cent. less than Krupp's cast-steel breech-loader, a statement we were unable to verify. The carriage on which this gun was mounted was an English service casemate-carriage, and is shown in the accompanying Fig. 46. Each rail of the chassis *a* is made of two pieces of boiler-plate united to flanged chords at the top and bottom by rivets. To give uniform stiffness to the rail it is made of the fish-bellied form between the traverse wheel forks or points of sup-

port. There is no pintle, therefore no tongue, to this carriage, and, in the absence of these parts, the traverse wheels are flanged and run on raised traverse circles, *b*, *b*. The front traverse-wheels have each two flanges, the rear wheels one. The chassis is traversed by a system of cranks and spur-wheels attached to the rear end of the chassis and operating on the bevel-geared portion of the rear traverse-wheels, *c*, *c*. There are two cranks, one at each end of a horizontal shaft; from this shaft another shaft extends obliquely downwards to another horizontal shaft near the traverse-wheels. Connections are made from one shaft to the other by bevel-geared wheels. Four men, two at each crank, are required to traverse the carriage. The flanges of the traverse-wheels serve to keep the wheels on the circles. The gun-carriage has two sets of manœuvring-wheels, known as front and rear wheels, *d*, *d*. The rear wheels are attached to an eccentric axle-tree, and, when thrown into rolling-gear by the handspikes, the weight of gun and carriage rests on both front and rear wheels. In this position it is run by hand both to and from battery. It is moved from battery by rope and pulleys, *e*. Power is applied to the loose end of the rope by taking some three turns of it around a drum on the crank-shaft and applying hand-power to the cranks. To prevent traversing the chassis at the same time that the carriage is drawn back, the lower portion of the traversing apparatus is thrown out of gear by a "shipper" provided for the purpose. A hydraulic buffer of the form used in Russian and Prussian carriages is placed between the rails and in rear of the gun-carriage, to take up the recoil. Oil, however, is used in this buffer in place of water or glycerine.

The elevating apparatus is similar to that employed on other foreign carriages, and is composed of a curved rack, one attached to each side of the breech of the gun, and operated by a pinion which is turned by a tangent screw or worm. The handle of the worm is shown at *f*. The motion of the carriage running to battery is checked by five India-rubber hurters attached in a row to the front transom of the chassis. A piece of wood is also attached to the gun-carriage to break the force of its shock against the hurters. The accompanying Figs. 47 and 48 show the modes of elevating and fastening the handspike of the Armstrong field-gun carriage. In the first the apparatus is composed of a curved rack attached to the knob of the cascabel, and worked by a pinion and crank. The gun is secured at any particular elevation by turning a cam working in the curved slot. The handspike when thrown back for use is held in place by a pawl which falls down and presses against a stud in front of the handspike-joint. The trail is formed of two pieces of boiler-plate stiffened at the edges by angle-iron riveted on.

Muzzle-loading field-guns only are used in the English service; the old breech-loading guns of the Armstrong pattern are issued to volunteer troops.

In the Armstrong collection is a breech-loading gun of 7-inch caliber and Armstrong manufacture. The breech-loading apparatus is the French plan modified by Captain Noble. The principal feature of the modification consists in moving the breech-block to one side when withdrawn by a rack and pinion placed below and at right angles to the axis of the bore. The loading-tube is attached to the same carriage with the block, and when the latter is removed the tube comes into place ready to be pushed into the loading-chamber. The charge of this piece is 22 pounds of powder and 110-pound projectile. An automatic lever covers the vent until the breech-block is locked, and thereby prevents accidents similar to one which occurred in France in firing a salute.

The gas-check is made of felt covered with sheet-brass, (Fig. 49;) as it is generally thrown out of the muzzle of the gun at each discharge it may be necessary to use a new one whenever the piece is reloaded. The projectile is lead-coated with raised ribs.

In this collection was noticed a 58-cwt. cast-iron smooth-bore gun converted into a 6.3-inch rifle on Major Palliser's system of a coiled tube lining. The charge for this gun is 8 pounds R. S. G. powder; projectile 64 pounds.

On account of the great economy of this mode of conversion, and requiring no new carriage, this gun is found to be well adapted for land fronts of fortifications.

SWEDEN.

In the Swedish department were exhibited a specimen of a large sea-coast gun mounted on its appropriate carriage, and several specimens of field-carriages, projectiles, small-arms, &c. The entire collection was very complete and neatly arranged. The body of this gun is made of cast iron re-enforced with steel rings. It is rifled with five grooves, and its breech-loading system is similar to the French. It has a novel arrangement to prevent the piece from being fired before the breech-block is properly locked.

The carriage is of iron, a combination of plate and angle pieces. The important features of the combination are shown in the accompanying sketches.

1st. The cheeks are composed of two 1½-inch plates united by transom plates, which give them the requisite stiffness in supporting the gun and sustaining the recoil. The trunnion-beds are made of bronze, and are united to the cheeks as shown in Fig. 50. The maneuvering-wheels are attached to the cheeks as shown in Fig. 51. The chassis-rails are formed of two plates, top and bottom, united by a single plate or web, strengthened with the necessary angle-iron riveted on, (Fig. 52.) The elevating-apparatus is shown in Fig. 53, and is composed of a curved arc fastened to the side of the breech, which is operated by a crank, worm, and pinion. The general features of this elevating-apparatus are similar to those in general use on the continent. The projectile for this gun is of the studded kind, and is shown in Fig. 54. The front studs are round, while those in rear are oblong in shape. The traversing-apparatus of the chassis is peculiar, being composed of a circular iron rack fastened to the platform behind the front traverse-circle. A pinion attached to a transom joining the rails works in this rack, and when turned by a worm in the usual way causes the chassis to move around its center of motion. (See Fig. 55.) A hydraulic buffer is used to take up the recoil. There are two sets of maneuvering-wheels, front and rear, and the piece can if necessary be run to and from battery by a rope and pulley combination attached to each side of the chassis. There is also a grip-block around which the loose end of the rope is wound to furnish the necessary friction to steady the carriage when running into battery. The maneuvering-wheels are arranged as on the original Russian carriage, to bring the gun-carriage automatically into battery after each discharge.

The body of the field-gun carriage is made of plate-iron stiffened at the inner edges by angle-iron. (See sketch, Fig. 56.) The caisson body and limber are each made of two pieces of angle-iron bent and riveted together as shown in the accompanying sketches. (Figs. 57 and 58.) The peculiar features of these carriages are: 1st. The mode of carrying the spare wheel, which is placed in front of the front ammunition-chest. 2d. The position of the pintle, which is placed sufficiently in rear of the

axle-tree to counterbalance the weight of the pole. 3d. The position of the spare wheel makes it necessary that the cannoneers should ride facing to the rear on the rear ammunition-chest. 4th. The spare pole is made in two pieces. As will be observed, the combination of the parts of these carriages is very simple, and the cost of construction must be comparatively small.

The Swedish military musket is of the Remington pattern. It is made by machinery on the American plan of manufacture, and a collection of parts in the various stages of finish formed a part of the exhibition. The bayonet-shank is forged solid and bored out. (Fig. 59.)

SWITZERLAND.

In passing through Switzerland noticed many places where target-practice with rifles was going on. The ranges seemed to be quite short, not exceeding in most cases 200 or 300 yards. Saw a battery of light artillery loaded on railroad-cars for transportation. The pieces were bronze breech-loaders. Their form was that of the Russian 4-pounder, but as the breeches were closely covered, the system to which they belonged could not be ascertained. The carriages appeared to belong to the French stock-trail pattern.

FRANCE.

The French cannon-foundry at Ruelle was visited on the 12th of September, 1873, by permission of the minister of marine. It is situated about 279 miles from Paris, by the railroad to Bordeaux, and near the city of Angoulême. The heavy cannon employed in the marine and sea-coast service of France are constructed on the system of General Fairbault, of the French marine artillery, and are composed of a body of cast-iron, re-enforced in the interior with a steel tube, and on the exterior with steel hoops. They are also breech-loaders, on what is known in France as a modification of the American system of Eastman.

The calibers of the cannon at present made at Ruelle are 14, 18, 24, 27, and 32 centimeters. The lining-tubes of the larger cannon are made by Firth, of Sheffield, England; the re-enforcing-hoops are by Petin & Godet, in France. The cast-iron body is made and the piece finished and assembled at Ruelle. The total cost of manufacturing large guns at this foundry was stated to be 1 franc 30 centimes per kilogram, nearly 12 cents per English pound. The tubes of the 14-centimeter guns are made of French Bessemer steel, a material which has not been found to answer a good purpose for guns of larger calibers. The breech-block is made of steel. The gas-check is a ring of pure copper, made on the Broadwell plan, and inserted into the mouth of the chamber. Its lip rests on another ring of copper, which is let into the face of the breech-block. The surfaces of contact of both rings have the peculiar grooves of the Broadwell system, to prevent the escape of gas. (See Fig. 60.) It is stated that this gas check is found effective for at least 150 fires.

The construction of the body of the large cast-iron rifle-cannon made at this foundry is shown in the accompanying sketch, (Fig. 61.) *a a* represent two layers of cast-steel hoops, enveloping the cast-iron portion (*b*) from the breech to a point a little in front of the trunnions. These rings are shrunk on, and, to prevent slipping forward, two shoulders are made, one in the cast-iron body and one in the forward hoop of the lower layer, as shown in the figure. The trunnions are attached to the forward hoop but one. The bore of the cast-iron body

from the breech to a point also in front of the trunnions is reamed up to receive the cast-steel tube (*c*) shown in the figure. This tube is held in place by a screw around its base, and it abuts against two shoulders, one at the forward end and the other in front of the screw. An initial strain is brought to bear on it by inserting it when the cast iron is expanded by heat, and afterward cooled. The precise number of hoops in each layer may not be correctly given in the figure.

The hoops are heated singly in a furnace of peculiar construction, which is shown in Fig. 62. *a* represents the fire-box of the furnace, *c* a platform of iron, which can be turned around by means of the crank and beveled wheels (*d*) so that the hoop (*b*) which rests on it can be brought in contact with the flame uniformly in all its parts. When the hoop has received "a blue heat" it is taken away and slipped on to the gun, which has been carefully turned to a given dimension to receive it. It is cooled in all its parts by an apparatus resembling a circular watering-pot, (see Fig. 63.) *a* represents the watering-pot, which is supplied with water through the hose, (*b*.) The inner surface of the watering-pot is perforated with numerous small holes, through which a spray of water is thrown over the entire surface of the ring *c*, enveloping the body of the gun, which is shown at *d*.

To heat the body of the gun for the purpose of inserting the lining tube, it is placed in the gun-pit of the foundery, and a brazier of burning coke placed over it. The construction of this brazier is shown in the accompanying sectional figure 64. *a* represents the body of the gun into which the tube is inserted; *b*, the lining of the brazier which separates the burning coke (*c*) from the gun; *d*, a lining made of fire-brick inclosed in a circular iron frame or cage, (*e*.) Vertical spaces are left between the fire-brick for the admission of air. The great size of the work and the nice fit of the tube necessitate great care in the turning and boring. No trace of the joint between the steel-tube and cast-iron bore of the body could be observed. That the work of the entire gun is made with great care and skill is shown by the weights marked on two 27-centimeter guns, which only varied some 22 pounds in something like the same number of tons.

The cast-iron body of the large guns is cast hollow, or around a solid core, no cooling substance as air or water being passed through it. The director of the foundry informed us that this mode of cooling cannon from the interior had been pursued at Ruelle since 1864, and was considered to be better than cooling by a hollow core, through which was passed a stream of air or water. The solid core referred to is formed in the usual way by wrapping straw-rope, covered with layers of fire-clay, around an iron-spindle. The spindle has longitudinal grooves cut in the surface for the escape of the steam and gases formed by the contact of the core with the melted metal.

The cast-iron made here is said to have great strength and to be well adapted for cannon. The tests of the qualities of the different irons, as well as those of the different powders used, are made in special trial-guns, which are made entirely of cast iron and of 27-centimeter caliber. They have the usual breech system attached, and are fired with service and increasing charges until they are burst. A large number of burst guns of this kind were observed neatly arranged in the gun-yard, and one trial-gun was being fired at the time of our visit for the purpose of testing a particular kind of powder. It had been fired ten times, and the gun was expected to burst before the end of the day. The initial velocities were taken by Boulanger's chronograph. Powder-

pressures are not taken in trials made at Ruelle, but are taken at the experiments made at Gavre.

The experiments which have been made in France with prism-powder gave, as we were informed, too great pressures. Experiments are now being made with a round powder made in Belgium and known as "Poudre Wetener." It was understood that the experimental guns at Gavre, from which a range of 11,000 meters is said to have been obtained, belong to the Fairbault system, except that the inner steel-tube extends completely through the bore, and that the piece is of great length. We were informed that the same system of construction had been applied to the field-guns of the French service, except that the body of the piece was made solidly of steel.

The projectiles which were being fired from the trial-gun were of cast iron, solid, and with a flat head. For service they are sometimes made of steel. They have each two bands to engage the rifling of the gun; the upper one is made of zinc, and the lower one of soft copper with two narrow grooves turned in it. (See Figure 65.)

The twist of the rifle-grooves increases from the breech to the muzzle. The grooves were numerous and very narrow.

The French breech-loading apparatus is quite simple in construction. It appears to work easily, and is considered perfectly safe. Instead of the long and heavy loading-tube required in the Krupp system, a light gutter only is required in the French system.

Sea-coast and naval-gun carriages are made at this foundry of wood, wrought iron, and cast iron. Noticed some rails for chassis and cheeks for gun-carriages, made of cast iron.

The workshops are substantially built of the white stone common in this part of the country, and are very conveniently arranged for carrying on work. The power is derived from a small stream of water which flows through the grounds. The water-wheels are of two kinds, undershot and turbine. The machines are strongly built, and at the same time of neat and of suitable design for the work to be accomplished, especially the boring and rifling machines. Guns are moved in the shops by a system of overhead cranes which run on wrought rails or girder-beams sustained by cast-iron columns. A crane was being put up to run entirely by water-power.

The arrangement of the melting and casting room of the foundery is very convenient. (See Figure 66.) *b* represents the melting-furnaces, arranged in a circle; *d* the gun-pit, concentric with the furnaces; *e* the crane with a chain made of sheet-metal links, and *f* a railway for transferring work to the heating and drying ovens and to other points. From each furnace there is a channel (*c*) cut in the masonry for the flow of the melted metal to the pits. There is also a circular channel connecting with the radial channels, and iron gates attached to it, for the purpose of shutting off the metal from a particular furnace from that of the others, or concentrating all the metal in one mold, at pleasure.

The neatness and order of the shops and yards for the storage of metals and guns were noticeable, especially as particular attention does not seem to be paid to such matters in other continental establishments visited by the board.

The facilities for doing work at this place will be understood when it is stated that one complete battery of field-guns was turned out from it per day for a considerable period during the late war.

On the 11th of September, 1873, a visit was paid by the board to certain private machine-shops at St. Denis, near Paris, where heavy iron

carriages are made for the French sea-coast and naval service. With the permission of the naval officer in charge of this special work, we examined a 27-centimeter center-pintle carriage, which is shown in plan, elevation, and section in the accompanying Fig. 67.

As the sketch from which the drawings in the figure are made was done from memory, the proportions may not be strictly true, but they may serve the purpose of giving a general idea of the construction and arrangement of the parts of the French heavy iron carriages.

As the gun mounted on this carriage is intended to fire over an iron shield, forming a half-turret, the axis of the trunnions is some seven feet above the plane of the traverse-circle. This will explain the apparent disproportion of the height of the gun-carriage to its length. The trunnion-beds are lined with brass to diminish friction, and covered with cap-squares to keep the gun in place.

The elevating apparatus is composed of a chain made of flat links, which passes under the breech of the gun, and is attached at its two ends to windlasses in the cheeks, which are each wound up by a worm working in a geared wheel attached to each windlass. The apparatus is worked by two hand-wheels, *t*. (See sectional view in Fig. 67.)

The cheeks of the gun-carriage *b* are each made of two plates of iron somewhat more than one inch in thickness, and separated at their edges by a flat bar bent to the required shape of the cheek. They are held together by through rivets, as shown in the figure.

The chassis-rails *a* are single solid bars of rolled wrought iron. The pintle *c* is cast hollow and bolted to the platform at its flange. To get the chassis as near the platform as possible, the traverse-wheels are attached to the ends of the rails by means of box-girder arrangements of plate and angle iron riveted together, *g f*. It is easily traversed by two men working at cranks operating on geared wheels attached to the rear traverse-wheels *e*. To give the wheels *e* a hold on the traverse-circles necessary to move the chassis, both wheels and circle are geared into each other. The front transom is *f* made circular in form, to work in a circular turret.

To the front transom is attached a cast-iron post, *h*, around which a stout breeching-rope passes to prevent the gun-carriage from overturning in case the friction apparatus and rear hurters fail in stopping the recoil. To this stop is attached a spring buffer, *i*, to prevent a shock to the gun-carriage when it runs to battery.

The rear truck-wheels *o* have eccentric axles, which, on being thrown into gear, bring the forward part of the carriage on to the forward truck-wheels, *p*, and place the whole gun and carriage on rolling friction. To facilitate the motion to and from battery there are pulley-blocks placed at both ends of the gun-carriage. The rear block is shown at *m*, and the front blocks at *n n*. The recoil is taken up by the friction produced by clamps acting on two sets of parallel plates *k k* attached to the chassis.

Each set is composed of eight plates. The amount of friction can be regulated by adjusting the handle *s* of the shaft which works the clamps. When adjusted the handle is held in place by a pawl attached to the side of the cheek, as shown in the figure. The final *pinch* on the friction-plates is given to the clamps when the short arm of the handle *s* strikes against the pawl *r* attached to the side of the chassis-rail.

The front transom of the top carriage is made of cast iron, and is very heavy; the breeching-rope passes through staples or loops attached to this transom.

The particular carriage herein described is very high and heavy

weighing from eighteen to twenty tons, while the gun only weighs about twenty-three tons. Its cost is said to be about $10,000.

Some carriages for smaller guns than the 27-centimeter were being made at this place, in which the chassis is formed by bending a single rolled beam into the form of the letter U, as shown in Fig. 68.

ENGLAND.

The British government establishment known as the Waltham Abbey powder-mills is situated on the same canal and about one mile north of the Enfield small-arms factory. It was visited on the same day with the small-arms factory, and under the guidance of Mr. Finlay, the foreman of the establishment.

The buildings are built principally of brick and scattered over a considerable extent of ground, as in other establishments of this character.

The grounds are low and flat and intersected by numerous canals, which, with covered boats, afford the means of transporting powder and materials from one building to another. A large portion of the grounds not otherwise occupied is planted with willow-trees, placed at regular intervals; the avenues are lined with Lombardy poplars.

The principal woods employed at this place for making charcoal are dogwood, willow, and alder. The dogwood is a species of alder-buckthorn, unlike the hedge buckthorn of this country. It is chiefly brought from Belgium, and costs about $15 per ton. It is used in the manufacture of charcoal for musket-powder, while the willow and alder are employed for pebble-powder. A seven years' supply of the different kinds of woods is kept on hand for the manufacture of charcoal.

The method of making charcoal is similar to that followed at Spandau, and is known as the "Prussian process." One peculiarity was, however, noticed, viz, burning the waste gases derived from the distillation of the wood under the iron retorts, for the purpose of saving fuel.

For pebble-powder the wood is subjected to a high heat for six hours, and the product is *black* charcoal. For musket-powder the heat is continued seven hours, but not so high as in the previous case; the result is *brown* charcoal.

Dogwood is here considered the best material for making all kinds of powder, but it is difficult to obtain. The size of the sticks in the large piles seemed not to exceed much more than an inch in diameter.

The niter is brought from India and refined in the usual way.

The sulphur is imported from Sicily and is refined by melting and running into blocks, which are broken up and ground into a powder. The apparatus contains a chamber, into which the residue of the sulphur from the kettle is sublimed.

The materials for powder, after being pulverized and weighed out in the proportion of 75 parts of niter, 15 of charcoal, and 10 of sulphur into lots of sixty pounds, are put each lot into a bag, and carried to the mixing-machine. This machine is composed of a revolving drum made of bronze, inside of which is a set of some forty-four arms attached to a sleeve around the shaft of the drum, and which revolve in the opposite direction from that of the drum.

The operation of mixing is quickly done, and the mixture falls out into a box, when it is taken to the wheel-mills to be incorporated.

The wheels are made of cast iron and weigh about 4½ tons each. Two wheels roll about the same vertical shaft and constitute a set. A charge of 60 pounds runs about 4½ hours.

There are some six sets of wheels in each building, separated by a

brick partition, as shown in the accompanying Fig. 69. Explosions in the wheel-mills take place on an average about once in every seventeen months, but are not, as a general rule, attended with serious results.

It was stated by the foreman that but two serious accidents had occurred in the entire establishment in thirty years. In the first explosion seven persons were killed; in the second one person was killed. The brick partition-walls are about 3 or 4 feet thick. The roof and outer walls are made of thin boards fastened to a light iron frame. Over each set of wheels is a tank of water, which is *spilled* by the upward action of a board. This board is attached to a shaft which runs through all the rooms, and when any one of the boards is lifted by an explosion the composition in all the troughs is immediately drenched with water, and the explosion is prevented from spreading.

There is also a cord and pulley in each room, arranged so that the troughs may all be drenched from the outside at the will of the workmen.

The incorporated cake formed under the wheels is taken to the "breaking-down mill" and reduced to dust.

To make "pebble-powder," the dust from the breaking-down mill is pressed into cakes or sheets about 15 inches wide, 27 inches long, and five-eighths inch thick. Figure 70 shows the arrangement of the various parts of the press for forming the cakes: *a* represents the hydraulic-press with its water-cylinder below the floor of the press-room; the box *b* for holding the composition is made of bronze and covered with wood. The box has in it two rows of twenty-four sheets each of bronze, held in racks about 1½ inches apart. The spaces between the bronze-sheets are filled with powdered composition, the box being placed with the edges of the sheets upward for the purpose. The racks which hold the sheets in place are withdrawn when the spaces are filled. The spaces filled by the racks are then filled up with more composition. The hinged top of the box is closed, the box turned over on its side and transferred by the overhead crane *c* to the press. The windlass *d* is for the purpose of raising the box before moving it to the press.

The dust is compressed *dry*. After compression the spaces between the sheets are reduced to five-eighths of an inch.

The piston being below, the contents of the box is pressed upward against a stout and thick piece of wood resting against cross-pieces, which are connected to the cylinder by stout tie-rods. When the compression of the composition is completed a bell rings automatically, and the workman shuts off the hydraulic pressure. A single charge for the press weighs 800 pounds, and it takes about twenty-five minutes to complete the compression.

The sheets are broken up into grains of nearly cubical form by passing them through two sets of fluted rollers at right-angles to each other. The rollers and all the principal parts of the machines are made of bronze. The edges of the flutes or knives for cutting the sheets, first into long strips and, second, into cubes, are made somewhat dull, to prevent the edges from turning. In splitting the cake they penetrate about one-thirty-second inch on each side of it.

The general arrangement of the parts of this machine is shown in the annexed Figure 71: *a* represents the sheet or cake to be broken into pebbles; *b*, the first set of breaking-rollers; *c*, the strips of broken cake lying on the endless band of cloth *d*, which transfers the strips to a second band of cloth, *e*, by which they are carried to the second set of breaking-rollers *f*; *g* represents the cubical pieces of cake, which fall into a revolving sieve, *h*.

The small pieces of cake are sifted out by falling through the meshes of the revolving sieve. The larger pieces are separated from the other pieces by hand. The pebbles are polished by rolling them in barrels. There are two operations in this process; in the latter operation a certain quantity of black lead is added to retard the inflammation of the powder in the gun.

The standard density of Waltham Abbey musket-powder is 1.72, while that of pebble-powder varies from 1.78 to 1.81.

A department of the Waltham Abbey mills is devoted to the manufacture of gun-cotton. The material used for gun-cotton is cotton-waste carefully picked over, to remove strings and other objectionable materials. After the waste is dried in a peculiar manner, it is soaked in nitric and sulphuric acids; it is then washed thoroughly and converted into pulp by machines similar to those used in paper-mills for cutting up rags. In the pulp form the gun-cotton is compressed into short cylinders under a hydrostatic press. The cylinders are about three inches in diameter, and one and one-fourth inches high. Gun-cotton in this form will not explode except by a detonator, or by a portion of dry gun-cotton. It is employed in the English service only for torpedoes, petards, &c.

The apparatus and machinery of this department appear to be new and very complete.

The Woolwich arsenal is situated on the Thames River, below and near London. It is devoted to the manufacture of cannon, cartridges, projectiles, ammunition, and other ordnance material for the British army and navy services. It is divided into the gun department, the carriage department, the projectile department, and the small-arm cartridge department, each under the separate command of a colonel of the royal artillery, who is termed the superintendent, and is directly responsible to the chief of artillery, stationed in London. Each head of a department in the Woolwich arsenal is assisted by one or more subordinate officers of the royal artillery, termed "assistant superintendents" or "instructors."

The workshops in the several departments are not laid out or built after any particular system, but are apparently the results of the successive growths of the establishment, covering a period of many years, but they appear to be well arranged for the work to be done, and the machinery appears to be of the latest and most approved description.

The cranes for lifting heavy material are scattered throughout the yard and are worked by hydraulic power after the plan invented by Sir William Armstrong.

The hydraulic press, the accumulator, and the steam-engine which works them, are placed near the river-bank, and the pressure is communicated through iron pipes for long distances. In this way the cranes are always ready for use.

Stores are transported from one point to another in the yard by a narrow-gauge railway, the track of which is formed of cast-iron plates with grooves in them for the car-wheels, at the same time the surface of the iron plates is checked to serve the purpose of a foot-walk. (See Fig. 72.) The roadways are formed of asphaltum concrete, and are very smooth.

In the British service all cannon projectiles are made of cast iron.

The blind shell or "chilled shot," for penetration in iron, is made hard at the point by casting the forward part in iron molds which chill it. The other portion of the shell, or body, is cast in ordinary molding-sand. The effect of this mode of casting a projectile is shown in some specimens split in two longitudinally. (See Fig. 73.) These projectiles are known as Palliser shot and shells. There is an orifice at the bottom

formed by inserting a screw-plug (*a*) into the mold in which the shell is cast. This projectile has no fuse, the powder-charge being ignited at the moment of impact by the heat generated; 12-inch shot of this description have been known to penetrate 18½ inches of iron. As chilled cast-iron shot break up into many pieces in penetrating iron plates, the penetration is said to be diminished by placing the plates at a certain distance apart; an arrangement which, by permitting the fragments to spread out, causes them to meet with increased resistance.

The live or common shell is much thinner than the blind shell, has a fuse-hole in the point, and is cast in sand molds. The fuse is the ordinary wooden time-fuse, with an igniter for the heavy guns. The shrapnel are similar in their operation to the old bullet-shell of Hotchkiss. The body is of cast iron, open at the top. After it is loaded with bullets it is closed with a wooden top, covered with a cup of thin wrought iron, which is riveted to the body of the shell. The powder-chamber is under the column of bullets and at the base of the body.

The powder is introduced into the chamber through a tube concentric with the mass of bullets, and its action is to project the bullets forward without rupturing the body, giving them thereby increased velocity in the proper direction.

This form of shrapnel is now employed for all calibers of guns in the British service.

The tin case of canister-shot is lined with segments of wrought-iron plates, sufficiently thick to prevent them from taking the rifling, and at the same time to protect the lands of the rifling from the action of the contained projectiles, which are cast-iron balls; the interstices are filled with sand and clay.

In the large rifle-projectiles fired with high velocity, the lower row of rifle-studs have been set forward and an intermediate row introduced, making three rows in all. The object of moving forward the lower row of studs is to diminish the length of the rifle-grooves in the direction of the bottom of the bore, and thereby strengthening the gun. The studs of the upper row are made narrow to fit the increasing twist of the rifling. All of the studs are made of brass seven parts, of copper and one part of zinc. The cavities into which the studs are fastened are undercut by a tool of simple construction, and the studs are forced in by a press, an operation which is performed very rapidly. The form of the studs and shape of the cavity are shown in Fig. 74. The quality of the iron used for projectiles at Woolwich is very carefully considered, and the mixture of different kinds of pig-iron to form it is the result of great research and experiment.

The surface of a chilled shot is made smooth with grindstones, and for this purpose it is placed in a revolving fixture, with the surface in contact with the stone. A variation of only 0″.03 is allowed in the diameter of a 12-inch shot, while the windage around the body is 0″.08, and that around the studs is 0″.05.

The surface of the studs is planed off in suitable machines. Iron flasks are used in molding, and the molders work in a circle, in the center of which is a crane for lifting the molds, patterns, &c. To prevent the points of chilled shot from splitting in cooling in the open air, they are placed point downward, and covered with sand for twenty-four hours.

Shells are tested by submitting them to a water-pressure of 120 pounds per square inch, which develops any small holes or cracks in the metal which might otherwise escape the eye. The interior of the shell is covered with a species of sealing-wax, which is made smooth by ex-

posure to a body of steam introduced through a pipe inserted into the fuse-hole.

(Drawings of the various kinds of projectiles in use in the British service will be found in Part II of Rifle Ammunition, published by authority, &c.)

The percussion-fuse is employed with all common shells. It is composed of a brass housing containing the exploding apparatus, and which is screwed into the fuse-hole. This apparatus consists of a plunger, on the top of which is the percussion-fulminate. This plunger is held in place at the bottom of the housing by a tube which rests on the plunger; it is also kept in place by a wire which passes through crosswise holes, and is held in by solder. This wire is pulled out just before the projectile is inserted into its piece, which allows the tube to press back against the plunger when the gun is fired. When the projectile strikes its object, both plunger and tube move forward, and explode the fulminate by striking it against a point fixed in the top of the housing.

Cartridges for cannon are kept in the magazine in zinc cans, which have water-tight covers and handles of galvanized iron. Each can contains a single cartridge, and is used as a pass-box for carrying the cartridge from the magazine to the piece.

The department for the manufacture of cannon, and known as the "gun-factory," was under the control of Colonel Campbell, R. A., assisted by Major Maitland and Lieutenant Jones, of the same branch of the service.

The board witnessed the operation of winding a coil for a 12-inch rifle.

The bar of iron to be coiled is heated in a furnace, which is some 200 feet long. The coiling-machine is quite simple, consisting of a mandrel turned by a powerful combination of geared wheels, as shown in Fig. 75. The end of the bar to be coiled has a hole which fits onto a pin on the flange of the coiling-machine, and to prevent the coils from overlapping each other the end is tapered, as shown in the figure. To make the coil as compact as possible, there is a pressure-roll bearing against the under surface of the coil as it is formed.

The coil is then placed in a furnace alongside of the steam-hammer, and when all parts of it have reached a welding-heat it is removed to the hammer and hammered, first endwise and then sidewise, until the entire mass is made solid. Sand is thrown on the heated mass as it is transferred from the furnace to the hammer to clear it of oxide, which might otherwise scale and prevent the surface from welding perfectly. There seems to be but little difficulty in welding the coils and getting sound work.

Inquiries were made about the practicability of welding large masses of low steel.

The foreman of the gun-shops thought it could be easily done. Mr. Fraser thought it impracticable. This question had reference to the experiments about to be made at the Springfield armory with the Hitchcock gun.

The experience at Woolwich in welding together large slabs of iron to form the trunnion-pieces of large guns, to say nothing of the numerous welding-surfaces in a large coil, would seem to favor the idea of making a homogeneous wrought-iron gun with proper appliances for doing the work.

Mr. Frazer and other gentlemen at Woolwich seemed to think the Hitchcock process impracticable. A vast sum of money has been spent by the English government in experiments in the manufacture of heavy

cannon. The result is seen in the Frazer gun, and with which those concerned in its manufacture seemed to be well satisfied.

Witnessed the welding of a coil for a Palliser tube. Three of these coils are welded together, end to end, by the pressure of a screw specially arranged for the purpose.

The interiors of all guns are carefully inspected by taking an impression of the bore in gutta-percha softened in warm water. Four impressions are necessary to cover the entire surface of the bore. The soft gutta-percha is spread along the side of a wedge-shaped stick, which stick is inserted into the bore; another wedge-shaped stick, the counterpart of the first, is also driven into the bore, pressing the gutta-percha into all the inequalities of the surface. (See Fig. 76.)

An examination was made of the impression taken in this way of the surface of the bore of a gun that had been fired between 400 and 500 times. The impression was taken over the seat of the charge, and very much resembled the bark of an elm tree in its roughness and deep furrows.

One great advantage claimed for the Woolwich system is, that its guns do not burst explosively, and when a tube cracks or is too deeply furrowed it can be replaced by a new one. When the surface of the bore over the seat of the projectile has become deeply furrowed by long firing, say 500 rounds, the old vent is closed, the piece turned over, and a new vent bored from the bottom, which then becomes the top of the piece.

The proof of heavy rifles in the British service is a service-shot with a charge of powder 25 per cent. greater than the service-charge. The piece is fired twice in this way and once with a service-charge.

The carriage department is under direction of Colonel Field, R. A., assisted by Major Oldfield, R. A. In it are made not only all the artillery-carriages for the army and navy, but the transport-wagons, ambulances, &c., for all branches of both services.

The new field-gun carriage, limber, and caisson are made almost wholly of plate and angle iron rolled for the purpose in the arsenal workshops.

The stock of the field-gun carriage is made of two pieces of boiler-plate, stiffened at the outer edges by angle-iron riveted on. (Fig. 77.) The trunnion-beds of this carriage are forged to the required shape, and welded to the angle-iron of the upper edge of the cheek, which is also welded to the lower piece of angle-iron, forming a continuous flange around the entire outer edge of the cheek.

The axle-tree is built up in the manner shown in Fig. 78, and is united to the stock by angle-irons riveted on to the cheek. The main portion of the axle-tree is of forged iron. To compensate for the lightness of the body this part is stiffened by two pieces of boiler-plate riveted on, one on each side, as shown in the figure and cross-section.

The handspike is of wood and detachable.

There is a small box with a lid-cover placed in the stock for carrying the smaller implements. There are also two seats for cannoneers on the axle-tree, one on each side of the stock.

The calibers of the field-guns are the 9-pounders (3 inch) and the 16-pounders (3.6 inch.)

The spare wheel on the caisson is carried between the body and limber. Two cannoneers ride on the front chest of the body of the caisson, one on each side of the nave of the spare wheel, and three cannoneers ride on the rear chest, facing to the rear. Shafts for the off wheel-horse are employed as usual in the English service.

The fortress-carriage in general use is similar to that noticed and sketched in the Armstrong department of the Vienna Exposition, except

that in case of the 12-inch rifle a provision is made to work the rear eccentric of the gun-carriage by a hydraulic jack attached to one of the checks.

In the naval carriage for this gun a rope and pulley is employed to work this eccentric in addition to the hydraulic jack, in case the latter should be out of order.

It was stated that some thirty Moncrieff depressing-carriages have been made and are now in the service. The cost of this carriage is very great compared to the ordinary carriage, but as they do not require an expensive casemate to shelter them their advocates claim that they are on the whole cheaper than the ordinary fortress-carriage.

A siege-carriage lately devised by Captain Moncrieff was shown, in which the force of the recoil is stored up by air and water in a large cylinder under the breech of the gun, for the purpose of raising it from the depressed position for loading to the position in which it is fired.

Also examined several specimens of muzzle-pivoting carriages, in which the power of raising the gun was hydraulic. Screws are employed to relieve the pressure of the gun on the water. A transverse section of this carriage, shown in Fig. 79, gives a general idea of its peculiar features.

Small-arm ammunition is distributed in the field by means of carts drawn by two horses abreast. Artillery ammunition is transported in wagons.

The naves of artillery-wheels are made of a bronze, the composition of which is 85 parts of copper to 15 of tin. The wheels are put together by hydraulic pressure, and held in place by wedges driven into the ends of the spokes. The general arrangement of the press is shown in Fig. 80, in which *a* represents the six hydraulic pumps, one for each felloe or each set of two spokes. A plate is applied over the center of the wheel to keep the spokes in proper place. The tire is fitted to the wheel by placing the latter on an iron plate so arranged as to float in a reservoir of water. Before the tire is fitted the wheel is submerged to swell the wood and prevent the hot tire from burning it; after the tire is applied to the wheel the plate is again submerged to complete the shrinkage of the tire and consolidation of the wheel.

Stores were being prepared and shipped from this arsenal in large quantities for the Ashantee expedition. Among them was a light iron carriage of very simple construction for a 7-pounder rifle-gun. (See Fig. 81.) There were also a large number of hand-carts for conveying all kinds of stores, and intended to be drawn by natives. The absence of roads and the density of the forests to be passed through rendered the usual carriages, drawn by horses or mules, impracticable.

The artillery practice-grounds are at Shoeburyness, about forty miles from London, near the mouth of the Thames.

The establishment is quite extensive, well laid out, and very complete in all the requisites for carrying on experiments, and giving instruction in the artillery branch of the British service. During the presence of the board two batteries of light artillery from the barracks at Woolwich arrived by transport to undergo a drill in siege-artillery, which was to last some nine or ten days.

In addition to the companies of artillery, there are some seventy artillery officers on duty, most of them for purposes of instruction.

Examined three Moncrieff carriages, with guns mounted on them for practice. One of the carriages was made on the original plan, as shown in the published reports, the other two (one for a 9-inch and one for a

6.3-inch Palliser gun) are of a later and more improved model. The mode of working these carriages under fire was shown for the information of the board, and was apparently satisfactory in every respect. The muzzle is depressed for loading, and a jointed ramrod is employed to push the charge home. The joint is made by screwing the end of the extension into a female screw formed in a socket at the end of the first joint. (Fig. 82.) The pitch of the screw-thread is made quick to facilitate attachment and detachment of the extension, which is only used in sponging and pushing the cartridge home.

A telescopic ramrod has been tried in the British service, but has not been found to work satisfactorily. An approximate elevation of the piece on the Moncrieff carriage is fixed before it is raised to the firing position, and carefully adjusted afterward. The operations of elevating and traversing are both done by cranks working geared wheels. The gun is raised to the firing position simply by releasing the compresser which holds the gun-carriage down after recoil.

The objections urged against this carriage are its complicated construction and the difficulty of depressing it by hand. The parapet partly overhangs the platform on which the gun is mounted.

Some practice was also shown with a 9-inch gun mounted on a barbette front-pintle carriage without the pintle. The target was a buoy on the water about 1,800 yards distant. The charge was 50 pounds of powder and a projectile weighing 250 pounds; some nine or ten rounds were fired in all from the various guns, and although the flight was accompanied with the peculiar "wabbling" sound of studded projectiles moving through the air, they all fell very nearly in a line with the target. The elevating apparatus, consisting of a combination of rack, worm, and pinion, is placed on both cheeks of the gun-carriage when mounted in casemate, as the position of the chassis may be such that one cheek may not be accessible to the gunner. In other carriages this apparatus is only placed on the right cheek. The traversing apparatus and all parts of the carriage appeared to work well. The hydraulic buffer checked the gun-carriage before it reached the rear hurters. When the rails are wet, however, the gun-carriage will reach the hurters. The general arrangement of the traversing apparatus and the hydraulic buffer is shown in Fig. 83.

An experimental siege-carriage was noticed. The cheeks of this carriage are made in a manner similar to that of the field-carriage already described, and the angle-iron at the edges is placed on the outside of the cheek. The peculiar feature of this carriage is the arrangement for shifting the gun from the firing to the traveling trunnion-beds, and *vice versa*, without the necessity of lifting it from the beds. This arrangement consists in removing the piece, *a*, Fig. 84, sliding the gun to the rear, and turning the piece *a* end for end, and placing it in front of the trunnions.

In both positions the piece *a* is secured by three screw-bolts, which pass through its flange and the angle-iron of the cheek. The elevating apparatus of this carriage is the usual combination of curved rack, pinion, and worm.

The worm is attached to the outside of the right cheek. The naves of the wheels are made of metal and the spokes are unusually strong and heavy.

A siege-carriage of this description was also observed with a howitzer mounted on it. The cheeks, however, behind the position of the elevating-screw were lightened by cutting away the inner portions of the plates or webs.

Experiments were being made by firing against a sunken battery constructed with a double parapet, somewhat like that shown in Fig. 85.

The inner slopes of the parapets were finished with gabions bound with strips of galvanized sheet-iron, and there was a furrow in the double parapet for sighting the piece. The firing against this parapet was from another siege-battery, distant about one-half of a mile. The projectiles were live shells.

Witnessed the tests made to determine the quality of metal of certain 5-inch wrought-iron plates, made by John Brown and Cammel, for the iron casemates erecting by the British government. A plate is selected as the representative of a lot of plates, suspended as a pendulum, and fired at with a 7-inch rifle-gun with a charge of nine pounds of powder and a projectile of 115 pounds. The distance between the plate and gun was 100 feet. The metal is considered to be of proper quality if the projectile barely passes through the plate, raising it in flakes on the back. It is condemned if the plate breaks or cracks badly.

Several old targets were observed which had been used for experimental purposes. One was a masonry casemate, which had been destroyed by firing into it; another was made up of plates of iron with the intervals filled with teak wood.

In still another target the original thickness of the plates amounted to 14½ inches, and it had a wood backing. These had been perforated through and through with 12-inch rifle-shot. Over the center of this target was placed a plate 4 inches thick, making a total thickness of metal of 18½ inches, which had also been completely perforated by a 12-inch shot, the powder-charge being regulated to reduce the velocity to what it would be at a distance of 1,200 yards.

The experiments with the Palliser chilled shot show that the body or soft portion of the shot breaks up in passing through armor-plates, but that the hardened point remains intact; and that spaces between the plates serve to diminish the penetration by allowing the fragments to spread out in these spaces.

The 12-inch chilled shot has three rows of buttons, while the shell of the same caliber has but two. Pebble-powder is employed in 9-inch rifles and upwards. Powder known as L. G. R. (large-grain rifle) may also be employed in the larger guns, but a certain reduction in the weight of the charge is necessary to compensate for greater quickness of burning.

In the British service the chassis is called "the platform," and the traverse circles "the racers."

Witnessed a detachment of non-commissioned officers drilling at loading and unloading a 9-inch gun on a raft made of commissary casks covered with balks and planks.

After our visit to Shoeburyness called on General Sir John Adye, chief of artillery, and thanked him for the permission he had kindly extended to the board to visit and examine the various establishments under his control. At this interview we were shown the report of certain experiments then being made in France to compare the English and French systems of field-artillery as regards range and accuracy of fire. The results of the firings were shown to the eye by colored rectangles which included all the shots at a given range. Targets of similar character were also shown which were made by certain heavy British guns. In the trials to which they referred the projectiles actually struck the ground and the position on the vertical plane of the target was calculated.

The grouping of the shots was very close, and in some cases there was actual coincidence.

Majors Benton and Crispin visited Firth's steel-manufactory in Sheffield on the 30th of September, 1873. The entire establishment employs about 1,000 workmen, and is devoted to the manufacture of cast steel in a great variety of forms, viz, for tools, bars, sheet, railroad-tires, cannon-tubes, &c. The material from which the cast steel is made is principally Swedish iron, of which there is a supply of some 18,000 tons on hand at the factory.

The process of manufacture is the old and reliable one of, 1st, converting the bar into blister-steel by cementation; 2d, breaking the bars of blister-steel into small pieces, and melting them in crucibles with coke and manganese; 3d, hammering the ingot under heavy steam-hammers.

The form of the cementation-furnace is shown in Fig. 86.

The bars of iron, weighing in all about 6 tons, are laid in layers in each furnace, interspersed with powdered charcoal, and subjected to heat for about six days.

The ordinary crucibles employed at this establishment are made of a whitish clay, similar to that used in making fire-brick. The clay is worked over or kneaded by the bare feet of the workmen, and then cut with a spade into blocks, each one of sufficient size to make a crucible. This block is then placed in a die, and by means of a plunger it is formed into a crucible, as shown in Fig. 87; after drying, the crucible is ready for use.

For the finer qualities of steel the crucibles are partly made of black-lead, and formed in a machine worked by steam. The punch is worked like an ordinary steam-hammer, and the dies, four in number, are arranged so as to rotate under it in succession. The blocks of material are shaped like the frustum of a cone, and the surfaces of the dies are smeared with oil to prevent adhesion.

The clay crucibles are used about three times, those of black-lead about four times, before they are broken up. The fragments of the old crucibles are utilized for making the bottoms and covers of new crucibles, and for this purpose they are pulverized by grinding them under stone wheels, arranged similarly to the incorporating wheels of a powder-mill, except that the trough or pan, which is made of cast iron, moves under the wheels instead of the wheels rolling over it.

The form of a crucible capable of holding about 40 pounds of iron, with a certain proportion of manganese, is given in the accompanying Fig. 88. The furnaces for heating the crucibles are beneath the floor of the melting-room, and are arranged as shown in the Fig. 89. Two crucibles are placed on one grate, and coke is poured on them from above and replenished as fast as it burns up. Two men tend a certain number of fires, and when the metal is ready for pouring the crucibles are lifted out and the contents of one poured into another, which is immediately seized by a pair of tongs resting on wheels, and run to the mold and deposited on a pile of sand. A workman at the mold seizes the crucible with a pair of tongs and pours the contents into the mold to form the ingot. A constant and steady flow of metal is kept up, and the surface is skimmed by another workman, who uses for the purpose an iron bar tipped with a piece of fire-clay.

The mold into which the melted steel is poured to form the ingot is made of cast-iron. The melted steel remains in direct contact with the sides of the mold some five or six hours, when it becomes sufficiently solid to be removed.

All steel in the ingot form needs to be hammered to give it a strong, uniform, and compact texture throughout the entire mass, and for this purpose it is found necessary to reheat it.

A Siemens gas-furnace, placed near the hammer, has been found to answer, and is the kind generally employed for this purpose.

The form of an ingot for a gun-tube is that of a frustum of a cone; under the hammer it is drawn out into the form of a cylinder about twice its original length, which is afterward turned and bored to the requisite size and shape.

The ingot for the new 80-ton Woolwich, when drawn out, is 25 inches diameter, 25 feet long, and weighs about 18 tons. The turning, boring, and tempering of the large tubes of the British guns are done at the Woolwich arsenal. All steel tubes for cannon are tempered in oil, an operation which increases their hardness, strength, and elasticity. Trial specimens, taken tangentially from rings cut from the end of tubes which have been tempered in oil, show in some cases a tenacity as high as 44 tons, or nearly 97,000 pounds to the square inch. The tempering apparatus consists of two iron tanks, as shown in Fig. 90. The tanks are made of boiler-plates, riveted together as in an ordinary boiler. The fuel for heating the tubes is wood, which is placed within the tank *a* and around the tube.

A number of tubes for French 24 and 27 centimeter rifle-guns, were observed in various stages of manufacture; also some rings for Vavasseur, whose mode of making guns is highly approved by Mr. Firth. The tubes for the French government are turned, bored, and tempered here.

We were informed that the French government had tried Bessemer steel for large tubes, but without success; out of forty tubes, nineteen were condemned for defects, while the remainder were more or less imperfect.

The large steam-hammers of this establishment are Wilson's patent and Naysmith's manufacture. The heaviest weighs 25 tons, but as it acts by the expansive force of the steam it exerts a much greater power than that due to its weight alone.

A great variety of merchant-steel is made here, especially for the American market; among many other kinds, sheets for circular-saws, seven feet in diameter, and forgings for locomotive-tires, which are rolled out and finished in the United States, thereby saving considerable import duty.

Cast-steel barrels for Martini-Henry rifles are also made here in large numbers. The material is first cast in the form of an ingot, weighing about 90 pounds. This is drawn out into a bar of the right length and then hammered to the shape of the barrel and drilled in machines similar to those in use at Sharp's factory in this country. The price of each barrel in the rough state, as it leaves the factory of the Messrs. Firth, is about $1.75, and the manufacturing capacity is about one thousand barrels per day. It is understood that the plan now generally followed in the United States of drawing out gun-barrels from short tubes by means of rolls is gradually superseding in England the plan above described.

Ordinary workmen at this establishment receive about thirty shillings per week; the best workmen somewhat more than this. Boys tending rolls for making the lighter kinds of steel bars, receive about twelve shillings per week.

The number of working hours per day at this establishment is ten, except Saturdays, when there is no work in the afternoon, as in other workshops in England.

J. G. BENTON,
Lieutenant Colonel Ordnance.

NATIONAL ARMORY,
Springfield, Mass., December 18, 1875.

NATIONAL ARMORY, SPRINGFIELD, MASS.,
August 9, 1877.

SIR: I inclose herewith certain notes on European small-arms, to be filed as an appendix to the copy of "Notes of an Official Visit to Europe," forwarded by me to the Ordnance Office December 20, 1875.

Very respectfully, your obedient servant,

J. G. BENTON,
Lieutenant Colonel Ordnance.

The CHIEF OF ORDNANCE, U. S. A.,
Washington, D. C.

NOTES ON SMALL-ARMS.

In the countries visited by the board the small-arms of the military service were found to be breech-loaders of the single-loading type in contradistinction to repeaters or magazine-guns. It was understood that Switzerland and Italy had adopted the Vetterlin magazine-rifle, but as these countries were not visited officially it was not ascertained if the adoption of this arm was general or only confined to certain corps and regiments. It is well known that Turkey has armed a large portion of her cavalry with the Winchester magazine-rifle, manufactured in New Haven, Conn. So far as known to the writer, therefore, these constitute the principal steps that have been taken to introduce magazine-arms in the military services of Europe down to the present time.

Great improvements have been made everywhere, and especially in Europe, in the last few years in military small-arms, whereby great efficiency has been gained by diminished weight of piece and cost of manufacture. The following may be enumerated as the principal changes on which these improvements are based, viz:

1st. The adoption of the rifle-grooves and the elongation of the bullet.

2d. The loading at the breech and the metallic-case cartridge, by which the joint is closed against the escape of the flame of the charge.

3d. The reduction in the diameter of the bore and the length of the barrel.

4th. The substitution of low steel in place of wrought iron in the manufacture of the principal parts, and especially the barrel, and the adoption of the American plan of manufacture by machinery, making all parts interchangeable for repairs. The reduction in the length of the barrel has been from 8 to 10 inches; the reduction in the diameter of the bore and the weight of ammunition will be shown in the following table:

	Caliber.		Powder.		Projectile.	
	Old muzzle-loading.	New breech-loading.	Old.	New.	Old.	New.
	Inch.	*Inch.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*
England	.577	.45	62	85	504	480
France	.69 and .72	.43	77	85	494	380
Prussia	.62	.45	86	80	360	320
Austria	.55	.425	62	65	450	318
Russia	.60	.42	80	80	560	375
Bavaria	.....	.45	66	66	675	340

The success of the Prussian arms in 1866 led to the prompt adoption of breech-loading arms by nearly if not all of the military nations of Europe. The haste to change was so great in many cases that the old muzzle-loading arms then in the hands of troops were altered to breech-loaders as a temporary expedient, to be used until new and better systems of breech-loading arms could be devised. As a consequence the military small-arms of Europe are now in a transition state, made up of altered muzzle-loading arms and new breech-loaders which are intended to replace them.

The new and altered systems of breech-loading small-arms employed in the different military services of Europe may be classed as follows, viz:

For alteration from muzzle to breech loading.

Country.	Name of system.	Motion of breech-block.
Russia	Krnka	Sidewise.
France	"A-la-tabatiere." (tobacco-box)	Do.
England	Snider	Do.
Turkey	....do	Do.
Austria	Wänzl	Upward and forward.
Belgium	Albini-Brandlin	Do.
Switzerland	Milbank-Amsler	Do.

For new breech-loaders.

Country.	Name of system.	Motion of breech-block.
France	Chassepôt	Sliding bolt.
Russia	Berdan	Do.
Prussia	Mauser	Do.
Austria	Werndl	Vibrating.
England	Peabody-Martini	Falling at the front end.
Turkey	....do	Do.
Bavaria	Werder	Do.
Sweden	Remington	Falling downward and backward.
Denmark	....do	Do.
Spain	....do	Do.
Holland	Remington-Beaumont	Do.

Since Prussia and France have abandoned the needle-firing paper cartridge, the self-primed metallic cartridge is everywhere employed in Europe for military breech-loading arms.

The general mode of priming the metallic cartridge is that known as "outside-center fire," which permits the empty shells to be reprimed and reloaded several times, proving a measure of economy when a large number of cartridges are required for target-practice in time of peace.

The material generally employed for cartridge-shells is brass; this material possesses more elasticity than copper; it therefore is generally preferred for reloading shells, as they retain their form and can be more easily inserted into the chamber of the gun when reloaded.

The heads of all cartridge-shells firing large charges of powder are either made solid, or with a folded flange which is afterward re-enforced with a thin lining of metal or a wad of paper.

The shells are generally made of bottle shape, that large charges of powder may be employed without unduly increasing the length of the cartridge.

Powder for military rifles of the various European services is of the size of grain known as Curtis & Harvey's No. 6. Great care seems to be taken to produce grains of uniform size and shape, to round off the sharp corners, and to free them from fine particles and dust.

The following descriptions of the most prominent breech-loading small-arms of Europe are taken, for the most part, from a work published in Munich in 1874, by Karl Theodore von Sauer, an officer of the Bavarian service.

Altered breech-loading small arms.

The French and English systems of altering small-arms to breech-loaders are substantially the same, the only difference being the relative size of the different parts. The French system is known as the "tabatière" or tobacco system, and is shown in Fig. 91. The English system is named "the Snider," after its American inventor, and is shown in Fig. 92. The number and function of the several parts being similar, the reference letters of the two figures correspond, and the same description answers for both.

The receiver or breech-frame is represented by the letter *c;* the breech-block by the letter *v*. The breech-block is hinged to the receiver in such a way that it can be revolved at right angles to the bore in opening and closing the breech, and slid back and forth on the hinge-pin to withdraw the empty cartridge-case. The lug *c h l* is the tongue of the breech-block hinge; the extractor *e* is attached to the axis of the hinge so as to move back and forth with the breech-block; when closed, the extractor fits into a recess in the receiver, with its point under the rim of the cartridge-head; the spiral spring *s p* forces back the breech-block and extractor to their places after the shell has been extracted to the position for closing the breech. The catch for holding the breech-block in place differs in the two systems. In the Snider it is a small pin, *k*, inserted into the receiver and forced forward into the breech-block by a spiral spring. In the "tabatière" system it is a flat spring, *f*, which is held in place by a screw at the rear end of the breech-block and fits into the small slot *k* cut in the receiver. In the Snider system, the firing-pin *s t* is secured by a screw-nut worked by a wrench; in the French system the same piece is held in place by a thumb-screw nut.

In both systems the breech-block is only locked at the moment of discharge, and then by the pressure of the hammer on the firing-pin.

The Snider system was at one time exclusively employed in the British army, and also in the armies of Servia, Montenegro, and Turkey, but is now being rapidly superseded by the Peabody-Martini system, which will be described further on.

The "tabatière" system has been almost entirely superseded in the French army by the Chassepot, first as a paper-cartridge gun, and lately as a metallic-cartridge gun.

Krnka system.

The system of altered breech-loading muskets of the Russian service is the invention of Sylvester Krnka, a regimental armorer of the Austrian army. Its chief features are simplicity and compactness.

Fig. 93 represents the breech system with the breech-block removed. The following are the principal parts, viz: *s t* is that portion of the breech-frame or receiver into which the barrel is screwed; *r* is the slot or well in which the breech-block rests when the chamber is closed; *m* is the hole into which is screwed the point of the hinge-pin around which the breech-block revolves; *l s t* is the lug in rear of the breech-block through which the hinge-pin passes; *c* is the groove by which the cartridge is inserted into the chamber; *r s t* is the lug which serves as a

support for the breech-block and a stop for the hammer, *h*; *e* represents the extractor in position; *e k* is the head with its oblique surface, against which the breech-block strikes when opened, to eject the cartridge-case; *t* is a small oblique cut on the corner of the flange-seat of the cartridge, to push back the firing-pin when the block is opened; *k* is a small catch-pin actuated by a spring which presses into a small indent in the front face of the breech-block and holds the block in place with slight friction; *d g* are broken lines, showing the position of the thumb-piece of the breech-block when closed but not locked down by the hammer.

The receivers of the muskets altered to this system in the Russian service appear to be made of bronze.

Fig. 93, *b*, represents the breech-block *v* detached.

The lower portion of the block is semicircular in form and has a groove, *n*, into which fits a raised band or rib, *r*, Fig. 93. The object of this arrangement is to increase the strength of the parts to resist the force of the charge. The rear corner of this rib is rounded off to prevent it from interfering with the insertion of the cartridge; *s b* is the striking-bolt, which with the firing-pin *l s* are shown fully in Fig. 93, *c*; *l s*, Fig. 93, *b*, is a small screw which fits into the notch *l* to keep the striking-bolt in place at the same time it allows the bolt free play; *a* is the notch into which the head of the hammer strikes, both to hold the block down and to explode the cartridge; the firing-pin *l s* is pushed back, as before stated, when the block is opened by the oblique surface of the notch, *t*, and also in closing the block, by the chamfered corner of the receiver *s t*; *c h l* is the ear through which the hinge-pin passes. The hinge-pin itself is shown in Fig. 93, *d*. The extractor is a lever of the first order, and is shown in Fg. 93, *e*; it is operated by opening the breech smartly, in which case the shell is thrown out clear from the receiver. The cartridge belongs to the center-fire system of Berdan, and is shown in Fig. 93, *f*. The shell is made of brass; the head is folded and strengthened with a re-enforcing-cap. The caliber of the Russian altered arms is 60, or 0″.6.

The Albini-Brandlin system.

The system of alteration which has been adopted in the Belgium service is known as the Albini-Brandlin. It is peculiarly fitted for transforming small-arms to breech-loaders, and, with the exception of the locking and firing arrangements, closely resembles what is known as the Springfield system of this country. The parts are shown in Fig. 94. The breech-block *v* is hinged at its forward end, and in opening swings upward and forward. The recoil is taken on the rear portion of the receiver by the vertical part, *s t*. At the center of this part is the hole *d b* through which passes the locking-bolt *s p s*. This locking-bolt is jointed to the hammer, and pushed forward by it when the lock is sprung so as to penetrate the recess *l* of the breech-block and hold it securely in place at the moment of firing. At the same time that the locking-bolt enters the recess it strikes against the head of the firing-pin *z s*, the point of which impinges against and explodes the primer of the cartridge. As the firing-bolt does not lock the breech-block when the hammer is at half or full cock, the spring catch-pin *k g* is provided which penetrates the recess *t* and prevents the block from getting loose under ordinary disturbing causes. The firing-pin *z s* is provided with a spiral spring to push it back and keep its point below the face of the block at all times except when pressed by the locking-bolt; this spring is kept in place by the screw-nut *v s v s*. The forward guard-screw o

b s penetrates into the rear portion of the receiver, thereby securing the barrel to the stock. The extractor is formed of two lever-disks, *e*, pivoted to the hinge-pin and outside of the ears of the hinge. Each disk is provided with a hook-point, *g*, which passes through a cut in the receiver and barrel and takes hold on opposite sides of the head of the cartridge beneath the rim. When the breech-block is thrown forward to open the breech its upper and forward edge strikes against the short arm of the extractor-disks and pushes them downward, at the same time the opposite or long arm is thrown to the rear, carrying with it the cartridge-shell. To throw the shell clear of the receiver the forward motion of the breech-block should be very quick toward its close. This extractor is very efficient, inasmuch as it gets a double hold on the rim of the cartridge-shell.

NEW SYSTEMS.

ENGLAND.

The "Martini-Henry rifle," adopted as the new small-arm of the British service, has a breech-loading apparatus on the Martini system united to a barrel rifled on the system of Henry, a gun-maker of Scotland.

Martini, a Swiss, derived his system of breech-loading from the Peabody system of this country, by dispensing with the independent outside lock and substituting therefor a spiral-spring firing-bolt or striker, inclosed in the breech-block.

The breech-loading apparatus, the rifle complete, the form of the rifling, and the cartridge are all shown in detail in the accompanying figures. Fig. 97 is a section taken through the axis of the barrel, with the breech closed. Fig. 97*a* is a similar section with the breech open.

The receiver G is a solid frame of iron, uniting the barrel and the front and rear portions of the stock. The barrel is shown at L, the tip-stock at V S, and the butt-stock at K. The point of the butt-stock is shaped to fit into the rear end of the receiver, which is cupped to receive it; it is fastened to the receiver by the longitudinal screw-bolt K S, in the manner shown in Fig. 97.

The several parts of the breech system may be divided into two groups, viz: 1. The falling breech-block and the firing apparatus contained in it; 2. The trigger and other parts attached to the trigger-plate, and the extractor.

The breech-block is pivoted at its rear and upper portion, and in uncovering the chamber of the barrel for the purpose of loading, its front portion falls, as shown in the position in Fig. 97*a*. The axis-pin *p s* around which the block turns is made of hard bronze. The portion of the collar surrounding this pin is embedded in the receiver and constitutes the principal recoil-bearing surface of the block. As this surface is above the axis of the bore, prolonged to the rear, there is a downward pressure of the block at the moment of explosion. This pressure is resisted by the short arm of the lever *b h* and the block thereby secured in its place. This lever, called the block-lever, is composed of two arms, and turns around the pin *n w*. The short arm of the block-lever is divided into two branches, as in Fig. 97*b*. The long arm serves as a handle by which the block is worked, and when closed its point enters a countersink and is held in place by a small catch-pin. The short arm of the block-lever works in the cut *v z* on the lower side of the breech-block. This cut is so shaped that the points of the branches of the

short arm working against its sides raise and lower the block and lock it. Fig. 97 shows the block in the locked position. Fig. 97*a* shows it in the position open for loading. The lever-pin *n w* is shown in detail in Fig. 97*c*. This pin passes through both cheeks of the receiver and is secured to the left cheek by a small screw, the head of which enters a groove in the point of the pin.

The firing-bolt or striker *d* lies in a hole extending nearly through the center of the breech-block. It is composed of its point, which projects through a corresponding opening in the head of the block; a collar, *t*, which serves as a shoulder for the spiral mainspring *s b* to press against, and the body enveloped by this spiral spring. The rear portion of the striker has a vertical slot, in which works the point of a lever to draw back the striker to the position of full cock. This lever is called the tumbler, and is shown at *n h*, in Fig. 97*a*, and in detail in Fig. 97 *d*. The rear end of the striker has a slot in it, that it may be adjusted by a screw-driver to receive the point of the tumbler *n h*. The striker is kept in place by a nut screwed into the rear end of the breech-block *v*. Fig. 97*e*, the forward end of the nut supports the spiral mainspring. The tumbler is pivoted on the same axis-pin as the locking-lever *n w*, and is placed between its two branches, as shown in the broken lines of Fig. 97*f*. To show when the striker is at full cock, the end of the lever-pin *n w* has an index-arm, which lies on the right side of the receiver and turns with the tumbler. It is for this purpose that the portion of the pin on which the tumbler fits is made square, as shown in Fig. 97*c*. The tumbler, when at full cock, is supported at *n k* on a rocker, *r s*, Fig. 97*g*, called the tumbler-rest. The nose of the trigger *a z* in turn supports the tumbler-rest at *r*, Fig. 97*g*. The tail-piece *s* of the tumbler-rest bears against the back of the trigger when the latter is pulled. The trigger-spring is shown in *d f*, Fig. 97 and Fig. 97*h*. To prevent accidents when the piece is carried loaded, the trigger is secured in place by the trigger-bolt *s c*, which is slid back and forth by pressing on the finger-piece *s c*, Figs. 97*k* and 97*m*. When locked, the bolt fits into the notch shown in Fig. 97*n*. The bolt is kept in place by the spring *s f*, Fig. 97*i*. The springs *d f* and *s f* are fastened to the trigger-plate by one and the same small screw. The position of the locking-bolt is known by reference to the small projection *m*, Fig. 97*k*. The same figure also shows the mode of combining the trigger, trigger-plate, guard-bow, and swivel.

The extractor *e* is a bent lever pivoted at *e s*. Its vertical arm is composed of two branches with points which hook under the rim of the cartridge to extract the shell. The horizontal arm is shaped to receive the downward pressure of the breech-block on its point and start the shell from the chamber. As soon as the shell has moved slightly the point of the breech-block strikes the arm near the fulcrum and ejects the shell with force from the piece. The extractor is shown in detail in Fig. 97*p*.

The form of the rifle-grooves is shown in Fig. 97*r*. The number of grooves is seven; in shape they are flat at the bottom; the lands are narrow, having the appearance of sharp ribs, which are designed to take a firm hold of the bullet. It is understood that these grooves are made somewhat deeper at the breech than at the muzzle. Twist is one turn in 22 inches. There is a brass collar around the head of the ramrod to prevent injury to the bore in wiping out. The triangular bayonet is issued with all arms to private soldiers. The sword-bayonet is issued to non-commissioned officers.

The weight of the Martini-Henry rifle is 8½ pounds; of the present

bayonet, 13½ ounces; of the new bayonet, 14½ ounces; of the old scabbard, 6 ounces; of the new scabbard, 4½ ounces. The weight of the rifle with the new bayonet attached is 9 pounds 11 ounces; with the old bayonet, 9 pounds 11½ ounces. A full-length view of the Martini rifle is given in Fig. 97*t*, and a muzzle-end view in Fig. 97*w*.

The cartridge adopted for the Martini-Henry rifle is made of wrapped metal, after what is known in England as the Boxer system. Each cartridge is composed of some fourteen distinct pieces, as shown in section in Fig. 97*s*. The body of the shell is made by wrapping a trapezoidal piece of thin sheet-brass around a cylindrical former, making a tube. One end of this tube is turned inward to form an interior flange for securing the shell to its head, the other end is reduced in diameter to fit the cylindrical portion of the bullet. A piece of thin paper is rolled up with the brass sheet for a lining to the shell to protect it against the action of the powder. The head of the shell is made of a perforated sheet-iron disk, *t*, two re-enforcing cups of thin sheet-brass, *k*, the anvil-pocket *g*, made of copper, and a paper wad, *c*. The relative positions of these pieces are shown in the sectional figure, and they are held together by the anvil-pocket and the paper wad, which is pressed into its place with great force under the head of the anvil-pocket, while the open end of the pocket is riveted to the disk.

The shell is primed by inserting into the anvil-pocket from the outside a primer composed of a percussion-cap of copper, *z*, and containing an anvil, *a*, also of copper. The bottom of the anvil-pocket has a small hole for the passage of the flame from the fulminate of the primer when it is exploded.

The bullet *c* is of the cylindro-conoidal form, made of lead hardened by an admixture of one-thirteenth part of tin. The bullet is slightly cupped at the base and has around it a slight groove, *r*, *r*, or cannelure, into which the cartridge-shell is choked to hold the bullet in place. The bullet is enveloped in a patch of thin paper, similar to that used for bank-notes. The lubricating material is a bee's-wax wad, *w d*, lying between the powder and bullet. This wad is separated from the powder by a stout paper disk, (jute,) c_2 c_2, and from the bullet by two disks c_1 c_1 of the same material.

The weight of the bullet is 480 grains, and the powder is similar in quantity to that known as No. 6, Curtis and Harvey's make, and weighs 85 grains. These cartridges can be reprimed and reloaded.

Since the Martini-Henry rifles have been placed in the hands of the troops certain defects have been developed, and the necessary alterations have been made to correct them. The most serious defect appears to have been the recoil or "kick" of the arm, extending, according to the newspaper accounts, so far as to disable soldiers after firing a series of not more than one hundred shots. The cause of this severe recoil is attributed to the great weight of the charge (powder and bullet) in proportion to the weight of the arm. The prominence of the stock in rear of the breech-frame contributes to the inconvenience of the recoil by striking against the face of the firer, if care be not taken to hold the piece properly. The injurious effect of the recoil is found to be the greatest with soldiers not accustomed to the use of the new arm, and diminishes as they become more accustomed to it. To remedy the evil as far as practicable it has been decided to lengthen the butt of the stock. Originally the distance from the trigger to the middle point of the butt-plate was 13 and 14 inches, and the two kinds of rifles were issued to the troops in the proportion of two of the former to one of the latter length. The corresponding distances now are 14 inches and 14½

inches, and the change is said to have gone far toward remedying the evil.

To protect the left hand from the heat of the barrel in rapid firing the portion of the barrel embraced by the hand is covered with a leather shield strapped and buckled on.

The butt-plates were formerly roughed by cross-hatching with a file to give a firmer hold against the shoulder. This has been dispensed with as unnecessary, and the surface is now left smooth.

The locking-bolt has also been dispensed with as unnecessary, and the block axis-pin is countersunk and made of steel instead of hard bronze. The strikers having been found to break, have been materially strengthened. The plan of screwing in the point of the ramrod to hold it in its place has been changed to a shoulder resting against a stop which is strongly secured to the stock below the tip, somewhat after the American plan.

The Boxer cartridges for the Snider and Martini-Henry rifles are made on a large scale at the Woolwich arsenal in what is known as the small-arm cartridge department. Although the number of pieces constituting a Boxer cartridge is much greater than those on the American plan of drawing the shell out of a single disk of metal, the cost of manufacture is low, inasmuch as the parts are made very rapidly in presses tended by boys. The cost of a single small-arm cartridge at Woolwich was stated to be about one penny.

The bullets are made in presses of very strong and solid construction, the principles of which are shown in the accompanying Fig. 97*z*. The lead, hardened by alloying it with one-thirteenth of its weight of tin, is drawn out into wire which is wound on a reel, and from this reel it is fed into a revolving disk of hardened steel, *a*, which is pierced with round holes of the precise diameter of the finished bullet. This disk revolves vertically, and as it passes the sharp edge of a piece of steel, *d*, pressing against its side, the lead wire is shaved off, leaving in the die a quantity just sufficient to form the bullet. Revolving a little further, two punches *f f* press on the lead in the die from opposite directions, and give it proper shape at the point and base. In one of the punches there is a small hole for the escape of any surplus lead, if there chance to be any. There is a slight cannelure in the surface of the Martini-Henry bullet into which the mouth of the case is crimped to secure the bullet in its place in the cartridge. These grooves are formed in a machine like that shown in the accompanying Fig. 97 *y*.

The bullets are rolled between a horizontally-revolving disk, *a*, and a confining rim, *c*. The edge of the disk and inner surface of the rim have a raised rib, which make the required indentation or cannelure in the bullet.

The bullet for the altered Enfield rifle differs from the Martini-Henry bullet, inasmuch as it has two cavities and three cannelures, Fig. 97 *x*. The cannelures are for holding the lubricants. The rear cavity has a clay plug in it for the purpose of expanding the lead, and the forward cavity is formed by a punch, and afterward closed over in a die. The object of this latter-named cavity is to give a proper adjustment to the position of the center of gravity of the bullet in firing.

Small-arm ammunition in the British service is distributed in the field by means of carts designed for this service and drawn by two horses. Artillery ammunition is transported in wagons.

Ninety cartridges per man is the annual allowance for target practice in the British service, viz: sixty (60) for individual firing, ten (10)

for file-firing, and ten (10) for volley-firing, and ten (10) for skirmish-firing.

The British government manufactory of small-arms is situated at Enfield, about fifteen miles north of London. It is conveniently laid out for doing work, and the buildings and machinery are of modern pattern. As the workshops are generally but one story high, the working-rooms are of great lateral extent, and are necessarily lighted through vertical windows in the roof, which is of the saw-tooth shape in cross-section. The power which drives the machinery is principally derived from a canal, the branches of which intersect the grounds and formerly furnished means for transporting heavy articles to and from the factory.

At the time of the board's visit the establishment was under the superintendence of Colonel Frazer, of the royal artillery, who explained the operations of manufacture and pointed out certain improvements which were being made in the machinery. About 1,000 Martini-Henry rifles are made at this establishment per week. By increasing the force of workmen and working extra hours, 3,000 rifles can be turned out per week. Eighty thousand rifles of this model had been made in all, but few had been issued to the troops, except for experimental tests. It is now understood, however, that they are being issued in such numbers that the entire British army will be armed with these new arms in the course of the present year, 1875.

The number of working-hours per day at this and other public manufacturing establishments is ten, except on Saturday, when but four hours' work is done. The average working-day, therefore, for the entire week is nine hours. This arrangement of working-hours is said to have been generally adopted in England. The most skillful workmen at Enfield, as, for instance, the smiths who forge the breech-frames, the tool-makers, &c., receive about $2 per day, while laborers receive only about 70 cents per day. The practice of working by the piece, as in similar establishments in the United States, exists only to a limited extent, owing to the strong opposition of the workingmen's associations to this plan.

The breech-systems of the Martini-Henry rifles are given to the filers in the milled state, who fit the parts, which are numbered separately for each system. It was thought that the improvements which were being made in the manufacture would eventually allow all the parts to be made interchangeable, as in the case of the original Enfield rifle-musket.

The barrels are made from full-length shapes of cast-steel, furnished by Messrs. Firth, of Sheffield. The process now generally in vogue of drawing out barrels under the rolls from short, thick tubes is about to be adopted as a more economical mode of manufacture.

The stocks are made of Italian walnut, which is considered the best in the world for this purpose.

The rifling is done by machines known in this country as "the Belgian rifling-machine." The peculiarity of these machines is that the cutter removes a heavy chip at each stroke of the rifling-rod, and the attention of one workman is constantly required to direct one machine. In the American rifling-machines the cutter cuts a very fine chip, and a single workman can manage as many as ten machines at the same time. The feed-motion of the cutter is arrested by an automatic arrangement so soon as the requisite depth is given to the grooves; after this the cutter performs the operation of polishing the surface of the grooves.

The breech-frame or receiver is made from low steel. The cavity in which the breech-block moves is formed by driving punches through the frame while it is being forged under a powerful steam drop-hammer.

The forging is completed in two heats. The cavity is finished by forcing a succession of broaches through it under the pressure of a powerful screw. To preserve the temper of the broaches the frame is immersed in a bath of soap-suds. The broaches are about fifteen inches long and of the requisite width and thickness. A new machine for face-milling the sides of the breech-frame has been lately introduced. In this machine some five or six frames are attached to the face of a wheel, which revolves vertically and brings the frames in succession between two revolving cutters or mills, which cut away the rough metal and make the finished surfaces equi-distant from the center of the cavity.

Band and other flat springs are forged in a machine with oscillating dies; this is a new machine and is said to work well. In place of the ordinary pony-hammer, the Rider hammer is employed for forging other light work. The blow in this hammer is produced by a series of cams on a horizontal shaft acting on a series of upright pieces, to the lower ends of which are attached the upper halves of the dies. The corresponding lower half of each die is pressed upward by a foot-treadle as the piece of metal to be forged is brought over it. This hammer has the advantage of running without the noise peculiar to the pony-hammer.

It was observed that soap-suds and soda-water, instead of oil, were generally employed to preserve the temper of mills and other cutting-tools.

When the several parts of each breech-system are fitted to each other, polished and numbered, they are then blued, browned, or case-hardened, as may be required. In actual service the browning on the barrels is found to wear about two years, when it is renewed under the direction of the regimental armorer.

In the volunteer service the arms are turned into store whenever it is found necessary to renew the browning.

The only variation allowed in the size of the bore is one-thousandth of an inch above the true size, 0″.45. Barrels are proved with charges of 420 grains of powder and one bullet.

The accuracy of the sighting is tested by firing at 500 and 1,000 yards ranges some twenty rifles taken from each week's work. After each breech-system has been assembled and attached to its barrel, the piece is fired with a heavy charge (300 grains of powder and one bullet) to test the strength of the working-parts and their connections. The loss in the manufacture and proof of barrels from all causes is only about 2½ per cent. This small loss is in a manner explained not only by the superior quality of the material—cast steel—but by the fact that the barrels are furnished in an advanced stage of manufacture by the contractor.

The hardware department of the Kensington Museum was visited and found to contain several articles of interest relating to the military service; among others, an instrument formed by the combination of a a spade, ax, and mantlet, called "The Burgoyne." (See Fig. 98.) This instrument is intended to form a portion of the equipment of a soldier, and to be used for digging rifle-pits, &c. When used as a mantlet against bullets, the soldier fires through a small hole in the blade. The handle is jointed to facilitate packing.

Specimen cards illustrating the modes of manufacturing triangular bayonets at the Enfield small-arm factory, and sword-blades by the Messrs. Wilkinson & Son, 27 Pall Mall, London, were also observed. As these modes differ in some particulars from those pursued in this country, the more important details are given herewith. In the manufacture of bayonets there are forty-nine distinct operations, the first

four of which are given as having an important bearing in the economy of construction, and as differing essentially from those of our own Government establishment.

No. 1 in the accompanying figure (Fig. 99) represents a round bar of iron cut to a suitable length for the socket. No. 2 represents a square bar of steel for the blade and shank. No. 3 shows the neck or shank formed by impressing a groove near the end of the steel bar. No. 4 shows the blade welded at right angles to the socket.

At the twenty-eighth operation the blade is bent parallel to the axis of the socket. The blade is apparently hammered out to length and shape instead of being rolled as in this country.

The several operations of making sword-blades are shown by specimens neatly arranged in the order of manufacture. The specimens are as follows, viz:

No. 1. A bar of steel, called a "sword mold," is given as it comes from the steel-maker. Each bar contains sufficient steel for two blades.

No. 2. The mold or bar, cut to test quality by an examination of the fracture.

No. 3. Mold drawn out and shaped ready for grooving.

No. 4. Mold shaped ready for welding on the tang.

No. 5. Mold drawn out, tang welded and grooved.

No. 6. Blade grooved and pointed. From 20 to 25 heats are required to bring the blade to this state.

No. 7. Forged blade hardened in water of 40° F. (Hardening at the maximum density of water is occasionally employed.)

No. 8. The forged blade hardened in water at 60°, (usual process.)

No. 9. The forged and hardened blade tempered in air.

No. 10. Forged and hardened blade straightened and tempered in oil 550° to 580° F.

No. 11. Forged and hardened blade straightened and tempered in wood saw-dust, (oak or beech.)

No. 12. The blade forged, hardened, tempered, and ground to shape ready for proving-machine.

No. 13. Ground blade tested by acid for "grays" or marks on steel.

No. 14. Blade proved and viewed ready for polishing.

No. 15. Blade glazed; first process of polishing.

No. 16. Blade polished ready for mounting and embossing.

No. 17. Blade embossed and etched.

No. 18. Blade burnished without glazing. This process leaves a hardened surface on the steel.

LIÈGE.

The city of Liège, in Belgium, is situated near large deposits of iron and coal, and is the seat of extensive manufactories of hardware, cannon, and small-arms. The manufacture of small-arms at this place dates back many centuries—in fact, from the first introduction of fire-arms as weapons of warfare. To secure the necessary strength in all fire-arms made within its limits, the government of Belgium established at an early date "a proof-house" for all barrels of small-arms made in Liège, (except those intended for the slave trade,) and the proof was conducted by government officers who were guided by government regulations, which have been strictly enforced down to the present time. Every barrel which successfully passes the proof and inspection is stamped with government marks; any failure to comply with the requirements of the government in the proof and inspection of barrels is punished

with severe penalties; it is this system which has given a high reputation to the arms made at Liège, and carried them into all the markets of the world.

During the forty-two years previous to 1864 there were 16,319,040 barrels proved at the Liège proof-house, representing arms the value of which was more than $100,000,000. At the present time about 1,000,000 small-arms are produced at this place annually, embracing almost every kind and caliber known to the world. Though some of these arms are sold as low as $1.65 each, they are all considered safe for the purpose intended. The number of workmen engaged in the manufacture of arms in the city is about 40,000. In consequence of the great variety of the arms made, and the cheapness of labor, but little of the work is done by machinery; most of it is done by hand in the small workshops at the homes of the armorers, who live in various parts of the city and its suburbs. The materials are given out from the workshops of the principal manufacturers on Mondays and the finished parts are returned on Saturdays, the transportation being done by the wives and daughters of the workmen in small carts drawn by dogs. The fitting and assembling of the parts is done under the immediate superintendance of the principal manufacturers, and this is about the only branch of the business that really calls for a knowledge of the art of gun-making. The wages earned by the workmen vary from $1, $1.25, and $1.50 per day of ten hours. A visit was paid to the government proof-house, and its various operations kindly shown and explained by the officer in charge, (called the "director") and his assistants. Among other facilities for doing work were noticed small railways passing through and connecting the different buildings. The barrels when proved are placed in grooves cut into the surface of an iron platform, and are held down by a heavy iron-bound stick of timber which is secured by screws. All the barrels in a lot of sixty are fired simultaneously by a train of powder connecting the vents. The barrels of breech-loading guns are also fired once or twice with the breech systems attached; after this they are returned to the makers to have the parts refitted and stocked. Revolvers, when proved, are fired by means of a wire passing through a hole in a strong wooden partition and attached to the trigger. The first proof of barrels is before they are finished. The proof-charges of course vary with the different kinds and calibers of guns to be proved. The proof-charge of the 0″.43 caliber military rifle is composed of a leaden bullet about 2 inches long and weighing 679 grains, and 170 grains of powder, which is made by the French mode of manufacture.

From the proof-house a visit was made to the small-arm factory of Mr. Francotte, which is one of the largest and most celebrated in Liège. Nearly every variety of pistols, shot-guns, and military arms are made at this establishment. The workmen were engaged in rifling a lot of smooth-bored muskets which were said to have been captured by the Germans in the late war and afterward sold to Spain. The rifling was being done on hand-machines, the great variety of arms made at this establishment precluding the use of automatic machines. The average amount of work of a single workman, in a day of ten hours, is eight barrels. Steel barrels are drilled from solid bars of the length and shape of the barrel, which is the form in which the bars are supplied by the steel-makers. The drilling-machine resembles a lathe, in which two barrels are placed side by side horizontally; when the drill has penetrated some 3 inches it is withdrawn to remove the chips, which would otherwise clog and retard the work. The steel bars for barrels for the

Chassepot rifle weigh in the rough 8.8 pounds, and cost about 80 cents each.

It was understood that the process of rolling out barrels from short, thick steel tubes, a process now generally adopted in this country, is followed in some of the small-arm factories of Liège. The finished boring of barrels is done in the ordinary way, viz, with a square cutter, the cutting-edge of which is pressed against the surface of the bore by a wooden splint, underlaid with one or more thicknesses of paper.

Attached to Mr. Francotte's factory is a museum which contains a very numerous and complete collection of specimen-arms, and especially breech-loading arms of modern invention. Among this collection were noticed revolvers for metallic cartridges with the simultaneous extractor, which Mr. Francotte stated was an invention known in Paris as far back as 1858 or 1859.

Attention was called to the Comblain rifle, a breech-loading arm resembling the Sharp rifle of this country. The mountings, receiver, and breech-block of this arm were made of phosphorus-bronze; the barrel is made of steel. Also noticed a specimen rifle in which all the metal parts were made of phosphorus-bronze. The militia of Belgium are armed with the Comblain rifle, while the regular troops have the Albini-Brändlin gun, which has a breech-block operating like that of the Springfield rifle, as previously described.

BAVARIA.

The breech-loading system of small-arms adopted in 1869 for the Bavarian army is the invention of J. L. Werder, of Nuremburg, and is known as the Werder system. It belongs to the class of falling breech-blocks of which the Peabody may be considered the exponent in this country. It differs, however, from this and most other guns of this class, as the breech-block is opened and closed by the hammer, instead of the lever-guard, giving, as claimed, greater safety and ease of manipulation, especially when the soldier loads lying on the ground.

The breech and lock mechanism of the Werder gun are contained in a box, the sides of which are two plates which furnish the bearings and pivots of the several parts. This box, with its contents of parts, is inserted in the vertical cut of the receiver, the front end of which is screwed to the barrel and the rear end is screwed to the stock by the tang screw, (*k s*,) Figs. 100, 100 *b*, 100 *c*, and 100 *d*. The guard-plate *a b* closes the bottom of the receiver, but has the necessary openings for the two triggers. The pivot-pins are riveted to the right side-plate, *s b*. The left plate has holes for these pivots, and also a projecting flange, *s g*, which forms a cover for the rear portion of the receiver-cut.

The breech-block is shown in V, and is pivoted at V W, which represents one of its trunnions. Its forward part is bored out for the firing-pin *z s* and the spiral retracting-spring *s p*. The firing-pin is held in place by the pin *f*, which works in a horizontal slot to give the necessary play. The extractor *e* has two arms; the long arm is forked, and each fork has a claw to seize hold of the rim of the cartridge-head. The forward part of the breech-block is cut away on the under side for the purpose of striking when it falls against the short arm of the extractor, thereby forcing the long arm, with the cartridge-shell, to the rear. The sear-spring *d f* serves the double purpose of a sear-spring and a spring for returning the extractor and breech-block to their proper positions for inserting the cartridge. It is supported by a bolster, *v s*, about two-thirds of its length from the extractor.

The hammer is shown in *h*, and occupies a central position between

the side-plates. It is composed of the following-named parts, viz: The comb or thumb-piece which projects from the right side of the breech system, the horizontal branch which passes under the curved cover *s g*, the part of the body which strikes against the head of the firing-pin *k*, and the full and half cock notches for the nose of the sear. The main-spring which gives the blow to the hammer is of horseshoe form, and is shown at *s f;* the end of one branch rests in a notch in the bolster *h s*. The locking-brace is pivoted at *d s*, and is composed of three arms, viz, *s*, the brace proper, which supports the breech-block through the projection *v f*, *d t*, the finger-piece, and *s k*, the rear locking-arm, which is forced upward by the projection *w* on the hammer to insure locking at the moment of full cock. The locking-brace is cut away to receive the sear and trigger, and both pieces work on the same pivot, *d s*. The locking-brace and trigger are shown separately in Fig. 100 *e*. Attached to the hammer are two arms, *h r*, one on each side, and between these points is a friction-roller, *r*. The object of this arm is to press the breech-block up to the position of covering the chamber when the piece is cocked, and that of the roller is to diminish the friction in passing over the curved portion of the block; it also assists in retracting the firing-pin, which it does by pressing against the projection on the under side of the head of the pin at *n*. The V-shaped spring *w f* acts upon the under side of the part of the breech-block in rear of its trunnions *VW* to depress the forward portion and uncover the chamber for loading, when pressure is brought to bear on the trigger *d r*. It also causes the forward portion of the breech-block to strike with force enough against the short arm of the ejector *e* to throw the shell clear of the gun. The upper surface of the breech-block has a groove, *l m*, to facilitate the insertion of the cartridge into the chamber. The projection *a s* forms a rest for the hammer when let down to its lowest point. The body of the firing-pin is cut away on its sides, so that its cross-section is a hexagon, thus diminishing the bearing-surface against the block, and rendering the pin less liable to be obstructed by dirt or rust. To open the breech-block for loading, press on the finger-piece *d r;* by so doing the support of the block is removed and it falls under the pressure of the spring *w f*, and in falling strikes the ejector, as before stated, and throws out the empty shell. To close the breech, push back the hammer to full cock, when the block is pressed upward by the arm *h r*. The projection *w*, acting on the curved arm *s k*, forces the point of the brace *s* under the projection *v f*, and insures the locking of the breech-block when the piece is fired. It will thus be seen that but one motion is required to open and one to close the breech and cock the piece ready for firing. If the arm is not to be fired at once, the hammer should be lowered to the half-cock notch to prevent accidental discharge.

The mechanism in its various stages of operation is shown as follows, viz: Fig. 100, loaded and cocked ready for firing; Fig. 100 *c*, breech-block at its lowest position for ejecting the cartridge-shell; Fig. 100 *b*, breech-block locked and hammer at its lowest point; Fig. 100 *d*, breech-block unlocked and hammer at the safety-notch. The complete rifle and its sword-bayonet unattached are shown in Fig. 100 *f* and Fig. 100 *g;* the cavalry carbine is shown in Fig. 100 *n;* the cavalry pistol in Fig. 100 *p*. Both carbine and pistol have the Werder breech-loading system. They are accompanied by wiping-rods; the carbine-rod is jointed to fold up after the manner of the handle of a parasol; and the pistol-rod is a single piece. The rifle-grooves are four in number, (see Fig. 100 *a;*) their depth is 0″.0075, and twist is one turn in 22 inches. The diameter of the bore is 0″.435; the length of the barrel, including

chamber, but exclusive of breech-frame, is 35″.0; the weight of the arm without bayonet 9.75 pounds. The cartridge belongs to the reprimed class known as "Berdan's." The construction of the head, with its pocket, primer, and re-enforcing-cup combined, is shown in Fig. 100 *i;* separately the re-enforcing-cup is shown in Fig. 100 *k*, and the primer at Fig. 100 *l*. The cartridge complete is shown in Fig. 100 *h*. The powder-charge weighs 66 grains, and is of the kind known as musket-powder. The bullet weighs 340 grains, and has three cannelures for lubricant, and a deep narrow cavity in the center of the base.

The cartridge for the carbine and pistol are similar in all respects to that for the rifle except the charge of powder, which is reduced to correspond to the weights of the carbine and pistol. The bullet is the same for the three arms.

AUSTRIA.

The new system of breech-loading small-arms, adopted into the Austrian service in place of the alteration of Wañzl, is the invention of Joseph Werndl, a gun manufacturer of Styria, and is applied to muskets, carbines, and pistols. The breech-block in this system vibrates around an axis parallel to and below the axis of the bore prolonged to the rear of the chamber. The principal parts are shown in section in Fig. 101: *c* is the receiver screwed to the barrel; the chamber and a portion of the rifling are shown at *p l*; V is the breech-block, which vibrates around the spindle *k*; *z s* is the firing-pin; H is the hammer; *l s* the firing-pin screw; *d a* the cartridge-shell extractor; *n* is the extractor-groove; *s p* is the striking-plate; *s t* is the spindle-bed with its fastening-screw and its wedge-shaped head; *v f* is the spindle-spring, which presses on K, the wedge-shaped head of the spindle. The receiver is screwed to the stock by the forward guard-screw *a s* and two rear guard-screws, which screw into the tang of the receiver or bed for the spindle.

Fig. 101 *a* shows the foregoing parts in position, as seen from above and rear of the gun, with the addition of the thumb-piece *d* and the screw *p s*.

Fig. 101 *b* shows the breech-block removed, with the extractor *a w* in position, and the hole *l v* for the point of the spindle K.

The extractor is shown in full in Fig. 101 *c*. Its shaft *d a* is imbedded in the front surface of the well of the receiver below the chamber. The point *d k* is notched to fit under the flange of the cartridge-head, while the point of the other arm projects into the groove *n* of the breech-block V. When this point comes against the end of the groove in turning the breech-block, the point *k r* is pressed backward and the cartridge-shell is thrown out. Of course the groove is arranged so that the extractor does not commence to move until the breech-block uncovers the cartridge-head.

The breech-block V is shown with its spindle in Fig. 101 *e;* the striking-plate in Fig. 101 *d*. The rear end of the breech-block has the form of a screw surface, the height or pitch of which is 5 millimeters, or about 0.2 inch. The front surface of the striking-plate corresponds to the screw at the rear end of the breech-block. The reason for this peculiar form is that the breech-block shall be pressed firmly against the cartridge head when closed, and shall be free to move the moment it begins to open. The striking-plate is slipped into its groove in the receiver and held in place by the small screw *p s*.

The slot *a*, in Fig. 101 *d*, permits the striking-plate to pass over the breech-block spindle, while that marked a^2 is for the passage of the hammer-head to the firing-pin. The rear of the striking-plate has a

projection over the spindle, partly for the purpose of giving a better bearing on the spindle and partly for the reason that the lug *h* forms a stop for the breech-block when closed. The portion *v* has a screw surface corresponding to the end of the breech-block, and to the wedge-shaped head of the spindle which is in contact with it.

The knob *k* serves as a button to secure the leather safety-cap which protects the firing-pin from being accidentally struck by the hammer.

The spindle K is the axis, around which the breech-block vibrates. The head of this spindle is wedge-shaped in cross-section, and lies with one of its flat surfaces on the spring *Vf* when the block is open or closed. The portion next to the head is cylindrical. Next to this it is square, that it may turn with the breech-block, and in front of the square portion it is cylindro-conical, as shown in Fig. 101.

The firing-pin is shown in the same figure and in Fig. 101 *k*. It is pressed back by a spiral spring near its point, and kept in place by the screw *l s*, which passes through a notch in the pin. The head of the pin has a slot for adjusting its position with a screw-driver. The lock is of the ordinary back-action pattern, and the hammer is raised to the half or full cock whenever the breech-block is opened, which is done by turning the thumb-piece *d* to the right, and closed by turning it back again to the left. The screw surfaces on the block, striking-plate, and spindle-head, act to force the block against the end of the barrel when closed, and at the same time press the extractor into its recess in the forward part of the receiver. When the breech-block is thrown open the groove *m* in it is brought opposite to the opening of the barrel for the insertion of the cartridge in the chamber.

The action of the spring *Vf* on the wedge-shaped spindle-head is very important, inasmuch as it keeps the breech-block in place when open and closed, and accelerates the ejection of the cartridge-shell. In the new model gun lately adopted and shown to the board in the artillery museum in Vienna this exterior flat spring was replaced by a spiral spring entirely inclosed and covered up in the receiver.

The barrel of the musket is made of cast steel. Its length is 33.14 inches, including the chamber, which is 2.07 inches. Its weight is 3.83 pounds. The rifle-grooves are six in number, and their depth is 0.007 inch. The lands are 0.07 inch wide, and the grooves 0.15 inch. The twist is one turn in 28.5 inches. The total length of this arm, (Fig. 101 *g*,) including its saber-bayonet, (Fig. 101 *h*,) is about 73.0 inches, while its weight, including the bayonet, is about 11.5 pounds. Without the bayonet the length is 50.5 inches, and the weight 9.85 pounds.

The barrel, bands, and sight are browned. The remaining parts are of a case-hardened gray color. The sight is of the Enfield pattern, and is graduated up to 1,060 meters.

The cartridge adopted for the Werndl arms is a solid-headed shell, drawn out from sheet brass, composed of 93 parts of copper and 7 of zinc. Its form is shown in Fig. 102. It has an outside center-fire primer, which is so arranged that there is no escape of gas from the charge. The charge is 63.0 grains of musket-powder. The bullet is made of soft lead, 1.18 inches long, and weighs 313.0 grains. It has a small expansion cavity in its base, two cannelures, and a rabbet for the bullet to fit into the mouth of the cartridge-shell. The bullet is lubricated by dipping the point as far as the shell into a melted composition of 7 parts of tallow and 1 of bees-wax. Attempts have been made in Austria to use compressed powder for arms of small caliber, and it is understood that this form of powder is still employed in the cartridges for the 2,000 Remington trial guns in the hands of the Austrian troops. The difficulties met with

in Austria in making compressed-powder cartridges on a large scale are to regulate the compression to suit the varying densities of service-powder, the mechanical difficulties to be overcome, and the danger from accidents. Therefore the results obtained in firing such cartridges are inferior to those of grain-powder in the loose state.

A breech-loading carbine and breech-loading pistol, both on the Werndl breech-loading plan, constitute portions of the small-arm system of Austria. The cartridges for these arms are similar to those of the rifle, except the charge of powder, which is reduced to correspond to the reduced weight of the arms, which are shown in Fig. 102 *a* and Fig. 102 *b*.

The Austrian army revolver is shown in Fig. 102 *f*, (one-tenth size.) It may be briefly described as follows, viz: Total weight, 2.9 pounds; total length, 12.0 inches; length of barrel, 7.2 inch; length of cylinder, 1.9 inches; diameter of bore, or caliber, 0.433 inch; number of grooves, 6; width of grooves double that of the lands; twist, one turn in 16 inches.

The cartridge-shell and bullet are the same as those employed for the Werndl rifle and carbine, the powder-charge is 20 grains less than that for the carbine, and the vacant space between the powder and bullet is filled with a wad.

The initial velocity is 524 feet.

With the exception of the locks, which are made at the imperial arsenal in Vienna, the Werndl rifles for the Austrian government are made by Mr. Werndl at his private armory in Styria. Mr. Russell, in a letter to the New York Times, of August 15, 1873, written on a visit to Mr. Werndl, states that 2,000 workmen are employed at this armory, and that 2,000 arms are turned out per week. The work is done principally by the piece, and skilled workmen make about $10 per week.

The capacity of the establishment is such that the number of rifles made weekly can be increased to 5,000. Mr. Werndl has, beside his Austrian contracts, a contract with Prussia for 160,000 Mauser rifles. His tools and machinery are of the American pattern, made by the Colt Patent Fire-Arms Co., of Hartford, Conn., and by English machine-makers. Much of the work in finishing the rifles made at this armory is done with the file, and the parts are not interchangeable.

In the artillery museum in Vienna was observed a spade for intrenching purposes. It was about the size of the small spade used for a similar purpose in the Army of the Potomac; the handle, however, has a joint by which it can be folded up and secured with a strap. (See Fig. 103.) It was stated that one of these spades is carried on the person of every third soldier.

Since the return of the board to this country, information has been received that a magazine arm has been introduced into the Austrian service called the "Turwurth repeating-carbine." Like the Swiss Vetterlin rifle, its chief peculiarity is the attachment of a cartridge magazine to a sliding breech-bolt system similar to that of the French Chassepot rifle. The only details of construction that have come to hand of this arm are contained in the two accompanying cuts, which represent a section through the axis of the breech system (Fig. 104) and a full length exterior view of the arm, (Fig. 104 *a*.) The arm can be fired eight times without reloading, viz, one cartridge in the chamber, one in the carrier-block, and six in the magazine. The operation of opening and closing the breech transfers one cartridge from the carrier-block to the chamber of the barrel and one cartridge from the magazine to the carrier-block. The eight cartridges can be inserted in the magazine in 12 seconds and can be discharged in 16 seconds. The arm without the bayonet weighs

8.1 pounds, and its length is 40.5 inches; with bayonet it weighs 8.95 pounds, and its length is 60 inches.

SWITZERLAND.

The Vetterlin repeating-rifle of the Swiss service is a Swiss invention, the peculiarity of which is the union of a cartridge-magazine with a sliding-bolt breech system. The complete arm, one-tenth of the natural size, is shown in Figs. 105 and 105*a*. Figs. 105*b* and 105*c* show the arrangement of the working parts on a scale of one-half of the true size. Fig. 105*b* shows the system with the breech closed as seen from the right side. Fig. 105*c* shows the system with the breech-bolt withdrawn, as seen from the left side.

The letter H represents the receiver or frame to which the several parts are attached. The rear of the receiver terminates in two tangs, top and bottom, between which the point of the butt-stock H S is inserted and held by a screw passing from the lower to the upper tang. The barrel is screwed into the forward part of the receiver in the usual way. The magazine M is a long tube attached to the under side of the barrel, and is capable of holding 11 cartridges end to end. The line of cartridges is pressed toward the opening of the receiver by a light spiral spring which terminates in a cap, *h t*. This spring is known as the magazine feeding-spring. The cartridges are transferred from the magazine to the chamber of the barrel by the combined action of the carrier-block Z and the breech-bolt which operates it through the agency of the bent lever pivoted on the part *z s*. As the breech-bolt is withdrawn the carrier-block rises in its vertical cut in the receiver H, with the cartridge in it, Fig. 105*c*; when the breech-bolt is pressed forward the cartridge is pushed into the chamber and the carrier-block falls back to its first position ready to receive another cartridge from the magazine, Fig. 105*b*. The body of the breech-bolt is a steel tube, C, Fig. 105*d*. Into the central hole of this tube is inserted the firing-pin *s b*, Fig. 105*e*. The point of the firing-pin rests in the crotch of the firing-pin fork *s g*, Fig. 105*f*, which is inserted into the horizontal slot *d s t* of the body of the breech-bolt. The prongs of this fork lie in two grooves on opposite sides of the solid head of the breech-bolt *c k c k*. The object of the two prongs is to strike in two places the fulminate of the cartridge, which lies in the rim of the head. The firing-pin is impelled by a spiral mainspring, *s g f*, Fig. 105*c*, which presses against the grooves *k b k b* of the wings *fl fl*, Fig. 105*e*. These parts are covered by the lock-case V *g*, which is secured in place by the flange of the lock-nut V *s*, by being screwed to the end of the breech-bolt. The point of the firing-pin *s b*, when it projects from the lock-nut, shows that the firing-pin is at full cock. The letters *s r* and *r r* show the full and half cock notches attached to the lower wing of the firing-pin. The sear is shown at *s t*, and its nose at *s l*. The sear-spring and its screw are shown at *s t f*, and the trigger is shown at *d r*. A short sleeve, N N, Figs. 105*b* and 105*c*, envelopes the body of the breech-bolt. To this sleeve are attached the handle of the breech-bolt *h g*, and the two locking-wings *f g f g*. The former is used to work the breech-bolt, while the latter are employed to lock it into corresponding grooves in the receiver, ready for firing. The forward end of the sleeve N abuts against the collar K *a*, which is solidly united to the body of the breech-bolt. The abutting shoulder of this collar is of slight helical form to secure the tight fit of the locking-wings against the shoulders of their corresponding grooves in the receiver.

The upper surface of the body of the breech-bolt has a groove into

which fits the cartridge-shell retractor *e*, shown in Fig. 105 *g*. The projecting part of the extractor fits into the groove *l n* of the receiver at the same time the cross-key *q s* serves as a stop to keep the breech-bolt from being withdrawn from the receiver. The other end *s p f* of the extractor acts as a stop for the rotary motion of the sleeve N. The extractor is held in place by the hook *e h* which passes under the cross-pin *e s*. In the groove Z N on the under side of the breech-bolt works the point of the small arm *v a* of the crooked feed-lever. The long arm *z h* of this feed-lever works in a horizontal groove in the carrier-block Z, Fig. 105 *h*, and raises it and depresses it when the foward or rear end of groove *z n* strikes against *v a*. The feed-lever spring is shown at *z f*, and the fulcrum to which the feed-lever is attached is at *z s*.

The cut in the end of the barrel for the hook end of the extractor to work in is shown at *e l*. The projection *m s* serves as a stop to prevent the feed-spring cup from passing beyond the magazine-tube. The movable piece *d s c h l* attached to the left side of the receiver by means of a screw is employed to cut off the cartridges in the magazine from the carrier-block when the piece is to be used as a single breech-loader, in which event the cartridge is inserted into the carrier-block from an oblong hole on the right side of the receiver. This hole is covered when not in use by the swinging piece *d k*, Fig. 105, which is held in place by the piece *k f*. The empty shell, after firing, is drawn back by the extractor attached to the breech-bolt, and thrown out clear of the receiver by the upward motion of the carrier-block, the upper portion of which is made of suitable shape for the purpose. The sliding piece *s d* is called the dust-cover, and serves to keep dust out of the working parts of the gun when not used.

Figs. 105 and 105 *a* show the complete gun and bayonet which is quadrangular. The cartridge-case is drawn out of sheet-copper, and the priming of fulminate is carried in the rim of the head. (See Fig. 105 *k*.)

The following are the principal dimensions and weights of the Vetterlin rifle:

Caliber	0.41 inch.
Number of grooves	4
Depth of grooves	0.0086 inch.
Width of grooves	0.0177 inch.
Twist of grooves	26 inches.
Length of barrel	33.14 inches.
Length of arm without bayonet	51.18 inches.
Length of arm with bayonet	70.08 inches.
Weight of arm without bayonet	10.14 pounds.
Weight of arm with bayonet	11.02 pounds.
Weight of powder charge	60 grains, (No. 4, Swiss.)
Weight of bullet	315 grains.
Weight of cartridge complete	470 grains.
Weight of rifle with magazine filled	12.12 pounds.
Initial velocity	1,341 feet.

The angle of sight, in minutes, for different ranges from 100 to 1,000 meters is given below, viz:

100, 200, 300, 400, 500, 600, 700, 800, 900, 1,000, meters.
12.16, 25.86, 41.15, 58.16, 77.13, 98.16, 121.46, 147.20, 175.60, 206.90, minutes.

The deviations for the "best half of the shots" for different distances are as follows, viz:

200, 300, 400, 500, 600, 700, 800, meters.
6.3, 8.6, 12.2, 16.9, 23.2, 31.1, 41.7, inches.

Experiments were made in Bavaria in the spring of 1872 by a military

commission to compare the rapidity of fire of the Swiss Vetterlin repeating-rifle and the Bavarian Werder rifle, which is a single breech-loader. It required 30 seconds to load the Vetterlin rifle, putting 11 cartridges in the magazine and 1 in the chamber, and 16 seconds to discharge the 12 shots. As a single breech-loader, the same arm was discharged 12 shots per minute. In the hands of experienced soldiers the rapidity of the Vetterlin and Werder rifles, both as single breech-loaders, was as 16 to 18 shots per minute.

PRUSSIA.

The Mauser is a modification of the Chassepot system by which it is adapted to the use of the metallic gas-check cartridge. The precise form in which it has been adopted by the Prussian government as a substitute for the needle-gun has not yet been made public, but it is understood that it does not differ except in some minor details from that shown in the accompanying diagrams.

Fig. 106 H represents the housing or receiver attached to the barrel by the usual form of screw at its forward end, and to the stock at its rear end by a tang-screw which penetrates through the stock to the trigger-guard. The general form of the receiver is a tube cut away at different points for the reception of the parts that work in and are attached to it. The breech is closed by a bolt called the breech-bolt, which contains the firing-pin and other parts necessary to the operation of locking and cocking. The principal part of the breech-bolt is the tube K, shown in detail in Fig. 106 *c*. The rib *w* on the exterior of this tube, known as the locking-tube, is for the purpose of locking into the space cut away in the receiver between *f* and *f*, to enable the breech-bolt to sustain the force of the discharge. The ends *b f b f* of this rib being made oblique to the axis of the bore, or rather of spiral form, and the ends of the cut *f f* being made to correspond, the breech-bolt is screwed forward against the cartridge when it is locked in loading. By this arrangement the cartridge is not only forced into its place in the chamber, should there be undue resistance, but accidental explosions which might arise from striking the head of the cartridge directly when the bolt is shoved forward, are avoided. The thumb-piece *h g* is attached to this rib for the purpose of working the breech-bolt. The breech-bolt is terminated in a separate piece, *k n r*, which is shown in detail in Fig. 106 *d* and the two cross-sections above it. By way of designation, this piece is called the bolt-head. The forward portion has a small round hole for the point of the firing-pin; the tenon, which enters the locking-tube, has an oval hole, that being the shape of the cross-section of the firing-pin which passes through it. The extractor-hook *e* is attached to the side of the bolt-head by means of a dovetail-tenon and works in a corresponding groove cut in the left side of the well of the receiver. The stud *h* fits into the notch *z k* of the rib, and is the means of uniting these two parts longitudinally, at the same time their motions around their common axis are independent of each other.

The cocking-piece *s p s* is shown in detail in Fig. 106 *e*. The lower front corner of this piece catches against the nose of the sear *a s* and holds the firing-pin at full cock when the bolt is shoved forward and the breech is closed. It has also a groove, *n a*, into which the nose of the sear projects when the firing-pin is pushed forward. The projection *d* works in a cut in the receiver H and thereby prevents the firing-pin from turning. The projection *k r* fits into a correspondingly shaped cut, *s p k*, in the locking-tube K, and by the pressure produced by the firing-pin spring keeps the breech-bolt in the locked position.

Fig. 106 *f*, *b s* represent the firing-pin nut, which secures the cocking-piece to the firing-pin. The projection *g* fits into the groove *n a*, and is thereby prevented from unscrewing. The parts marked *a f* and *a s* are the sear-spring and sear combined in one piece. This piece is attached to the lower side of the receiver by a screw; the portion through which the screw passes serves as the ramrod-stop. The trigger *a z* is pivoted to the sear, and is composed of an arm and finger-piece.

Fig. 106 *b* shows the firing-pin and its spiral spring, made of square instead of round wire. The portions in front and rear of the spring are made oval in cross-section to prevent the pin from turning in locking. The re-enfore *t* forms a shoulder for the spring to press against.

Fig. 106 represents the firing-pin in the position of resting on the head of the cartridge after firing. Fig 106 *a* shows the firing-pin in the position of full-cock ready for firing. As the piece is brought to the position of full-cock in loading, an improvement has lately been introduced into this arm for locking the firing-pin in case it is not to be fired immediately, and thereby preventing accidental explosions. The motion of the breech-bolt to the rear is limited by the sear *a s*, which works in the groove *n n* on the under side of the locking-tube K. To remove the bolt entirely from the receiver it is only necessary to press on the trigger at the same time that the breech-bolt is pressed back. The recess *n a* serves to relieve the strain on the sear-spring by allowing the nose of the sear to penetrate it. The firing-pin screw *b s* is removed with the fingers (having a milled head) by pushing back the firing-pin and slipping forward the cocking piece so as to free the projection *g* from its recess. The spring of the extractor allows the hook to pass over the flange of the cartridge into its recess in the barrel. The screw-motion of the locking-tube gives power to start the cartridge-case should it adhere to the chamber. When withdrawn, the case falls out of the receiver by slightly tipping over the barrel to the right.

The following are some of the principal weights, dimensions, &c., of the Mauser rifle and cartridge as adopted for the Prussian military service: The bore is .433 inch (11 millimeters) diameter, and is rifled with four flat grooves, equal to the lands in width; the depth of the grooves is .01 inch, and the twist is from right to left and one turn in 33 inches. The length of the barrel is 33.65 inches; the total length of the rifle without bayonet is 53.15 inches; with bayonet, 71.65 inches; weight, without bayonet, 10 pounds; with bayonet, 11.6 pounds.

The sight is arranged for a natural point-blank of 300 meters. The movable part is graduated up to 1,600 meters, some 500 yards farther than most military rifles. The initial velocity is about 1,400 feet.

The cartridge-shell is drawn out in the usual way from a disk of sheet-brass, and is of "bottle-shape," (see Fig. 106 *h*,) natural size. The head is solid and has an exterior primer of the Berdan pattern. This distribution of the metal in the head is somewhat different from that in ordinary solid-head shells, and is such as to give it great strength to resist rupture under the pressure of the powder. The interior of the cartridge-shell is covered with a coating of varnish to prevent the metal from acting injuriously on the powder-charge. This varnish is applied by means of very ingenious machines devised and made by the Pratt and Whitney Company, of Hartford, Conn.*

The bullet is patched with bank-note paper, thin and strong, and there is a lubricating-wad between the powder and bullet. The powder-charge

*A very large amount of machinery for the Prussian government has been made by the same firm and placed in the new small-arm factory at Spandau for the manufacture of the Mauser rifle.

is 77 grains. The powder for the Mauser rifle differs from all other Prussian powder, inasmuch as red charcoal instead of black is employed in its manufacture, which is thought to give it greater strength. The size and shape of grain are similar to that of the English musket-powder, known as Curtis and Harvey's No. 6. The bullet weighs 386 grains, and its shape, which is somewhat peculiar, is given in the annexed Fig. 106 *m*, which is three times the natural size.

FRANCE.

The Chassepot rifle was introduced into the French service shortly after the Austro-Prussian war of 1866. In its principal features it resembled the Prussian needle-gun, inasmuch as the breech was closed with a sliding bolt, and it fired a self-primed paper-case cartridge which was ignited by a needle impelled by a spiral spring. Unlike the needle-gun, however, it was provided with a gas-check, which was of the form of a thick India-rubber disk or packing, attached to the end of the breech-bolt, and it possessed the modern improvements of reduced caliber and rapid twist of the rifle-grooves for obtaining great range and accuracy of fire. The range of the Chassepot rifle was, and is now, comparatively greater than the accuracy of the flight of its projectile, a fact that undoubtedly arises from the great weight of the powder-charge in proportion to that of the projectile and a want of proper adjustment of the twist, &c., of the rifling to the velocity of flight. In the French service a low trajectory has ever been considered of greater importance than accuracy of flight, especially in line-firing. The Chassepot was the principal arm used by the French army during the German war. Since that time efforts have been made to adapt it to fire the modern metallic-case cartridge. The plan of alteration to this end adopted by the French authorities is that submitted by Captain Gras of the French artillery committee. In consequence of the great opposition offered to the altered arms by officers of the army who have had them in their commands, it is understood but little progress was at first made in the manufacture of new rifles or altering the old Chassepot rifles to the "Gras system."

The Gras system of alteration consists, 1st, in reaming out the old paper-cartridge chamber and inserting in its place a bushing of steel in which a chamber is formed of suitable shape for the metallic cartridge; 2d, replacing the India-rubber gas-check and its attachments by a nose-piece, to which a cartridge-shell extractor-hook is attached; 3d, replacing the firing-needle with a stout firing pin or bolt; 4th, removing the friction-roller in the base of the thumb-piece and replacing it with the firing-pin nut; 5th, changing the form of the locking-notches and the side groove of the body of the breech-bolt.

Fig. 107 represents the exterior of the breech system with the breech-bolt withdrawn to the position for loading and cocking. Fig. 107 *a* is a section of the breech system taken by a vertical plane through the axis of the bore. The remaining figures represent the principal parts of the breech system separately and in detail.

The breech-frame or receiver H is secured at its front end by screwing on to the barrel, and at the rear end by the tang-screw *k s*, which penetrates through the guard-plate on the under side of the stock. The breech-bolt K, Fig. 107 *b*, is composed of a body in the form of a stout tube, with a handle, *h g*, attached to one side, for the purpose of working it. The hollow of the body contains the firing-pin and its spiral

spring, and has a nose-piece to which the cartridge-shell extractor is attached. A slot is cut in the upper surface of the receiver through its entire length. The handle works in the rear portion of this slot, while the forward portion is enlarged by cutting down the right wall of the receiver to furnish a shoulder for the base of the handle to rest against when the bolt is locked and the piece is ready for firing. On the side and bottom of the body of the breech-bolt are two long grooves of rectangular cross-section. The groove *n* on the side receives the point of the screw *k l s*, Fig. 107 *b*, and serves to guide the bolt in opening and closing the breech. The object of the spiral direction of this groove at its rear end is to force the handle into the cut of the receiver before the face of the nose-piece presses against the cartridge-head, and thereby prevent the bolt from flying backward in case of a premature explosion of the cartridge. The groove *n* on the under side of the body is for the nose of the sear to play in without pressing on and impeding the motion of the bolt.

The firing-pin *p* is shown in detail in Fig. 107 *c*. It is made of steel. The body of the pin, which is enveloped by the spiral mainspring shown in Fig. 107 *a*, by the rows of small circles above and below it, is circular in cross-section. The collar *c* offers a shoulder for the mainspring to press against. The portion of the pin immediately in front of the collar is oval in cross-section, corresponding to the hole in the nose-piece, through which this portion of the pin passes. This form of the pin prevents it from turning in the nose-piece when the bolt is locked and unlocked, and regulates the motion of the thumb-piece relatively to the breech-bolt.

The nose-piece is shown in Fig. 107 *d*. It is attached to the front end of the breech-bolt by means of the projection *a*, Fig. 107 *b*. The cylindrical projection *b* on the nose-piece also fits into corresponding recess *b* in the forward end of the bolt. The recess *c* is a continuation of the groove *n* on the side of the bolt, and receives the point of the screw *k l s*, which serves as a stop to the bolt when pulled backward, and also to prevent the nose-piece from turning in the receiver when the bolt is locked. The under side of the nose-piece has a continuation of the groove *n* in the bolt for the nose of the sear. A cut, *d*, extends through the upper portion of the nose-piece to receive and hold the extractor-hook, in the manner shown in Fig. 107 *a*. The extractor-hook itself is shown in detail in Fig. 107 *e*. It is composed of two branches, the lower one of which has a hook which takes hold of the rim of the cartridge. (See Fig. 107 *a*.) Its body has a certain elasticity which allows it to pass over the rim of the cartridge, while its hold on the rim is secured by the inclined surface of the cut *e* made in the receiver, into which the extractor fits. It also serves to keep the extractor in place in the nose-piece.

The small screw *s*, Fig. 107 *a*, acts as an ejector-stud for the cartridge-shell.

The thumb-piece S is shown in detail in Fig. 107 *s*. The nut which secures the thumb-piece to the firing-pin is shown in Fig. 107 *f*. This nut has a milled head and a T-shaped groove in it, which fits on to the head of the firing-pin. The pressure of the mainspring on the pin prevents the nut from coming off by keeping it in its recess in the thumb-piece.

The nose *e* of the thumb-piece fits into a corresponding notch *e* of the rear end of the body of the breech-bolt (Fig. 107 *h*) when the firing-pin is pushed forward against the cartridge-head and the bolt is locked.

There is also a slight notch at *s*, (Fig. 107 *h*,) in which the nose rests to give the handle steadiness when in the vertical position. When the firing-pin is drawn back to the full-cock position the lower corner *n* Fig. 107 *s*, of the thumb-piece rests against the nose of the sear. At half-cock the nose of the sear rests in the notch *n'*, holding the point of the firing-pin at a safe distance from the priming of the cartridge. The notch *n''* receives the nose of the sear when the point of the firing-pin impinges on the head of the cartridge. The upper portion of the thumb-piece is cut away and its surface checked to give a good hold to the thumb and fingers in manipulation.

The sear *s t*, Fig. 107 *a*, is attached to the under side of the receiver by two screws *f f*. The smaller screw acts as a keeper to the larger. The body of the sear is a flat spring, so set as to cause the sear to protrude through a cut in the receiver and engage the notches of the thumb-piece.

The trigger *a d*, Fig. 107 *a*, is a lever of the first order, and is attached to the sear by a joint-pin, *i*. Pressure on the finger-piece of the trigger depresses the nose of the sear, the rounded part of the trigger acting as a fulcrum against the under side of the receiver.

The cartridge adopted for the altered Chassepot rifle is shown in Fig. 107 *k*. The case is "bottle-shape" and drawn out of sheet-brass in the usual way; the head is strengthened after the Hotchkiss plan, and it has the outside primer of Berdan.

The bullet is solid and without cannelures, and weighs 386 grains; the powder-charge is 81 grains, and there is a lubricating-wad of the usual form between the powder and projectile.

The length of the bore, including the chamber, is 32.28 inches; the length of the complete arm, without saber-bayonet, is 50.8 inches, and with the bayonet it is about 72.0 inches. The complete arm and its bayonet are shown in Fig. 107 *m*. The weight with the bayonet is 10.3 pounds; without the bayonet, 8.9 pounds. The grooves are four in number, and of a width equal to that of the lands, (see Fig. 107 *n*;) the depth of the grooves is 0.0118 inch; the twist is one turn in 21.6 inches, and is from right to left instead of from left to right, according to the usual practice. The pull on the trigger is thought to disturb the aim by carrying the muzzle of the arm slightly to the right; the object of grooving the barrel to the left is to correct this disturbance by the drift which follows the direction of the twist.

The initial velocity is stated to be 420 meters, (about 1,377 feet,) and the effective range extends to 1,700 yards, about one mile. The rapidity of fire is 15 times per minute.

RUSSIA.

In 1873 the main body of the Russian infantry was armed with the old muzzle rifle-musket altered to a breech-loader on the system of Krnka. The number thus altered was said to be about one million. The sharpshooters were armed with two patterns of Berdan breech-loaders. One lot of 30,000, in which the breech-block swings upward and forward, was manufactured by the Colt's Patent Fire-Arms Company, Hartford, Conn., and a second lot of 30,000 on a sliding-breech-bolt system made in Birmingham, England. The board was informed that the latter-named arm, with its reduced caliber of 0.42 inch, had been adopted as the new rifle-musket for the entire Russian army, and that the machinery, tools, &c., of the government small-arm factories were being adapted to its rapid manufacture.

Owing to the distance of the principal manufactory and the short time at the disposal of the board, it was not visited. It was understood, however, that the machinery and mode of manufacture were similar to those of the United States.

The Russian sliding-bolt-breech system for small-arms is shown in the accompanying vertical section, taken through the axis of the bore, (Fig. 108.) The breech-receiver H is attached to the barrel in the usual way, and the rear end is secured to the stock by a tang-screw. The receiver has a cut on its upper side extending from the barrel back to the tang, and it is in this cut that the breech-bolt with the locking arrangement moves back and forth; it has also a cut on the lower side in which the trigger, sear, and ejector operate.

The breech-bolt is shown at K. It is bored out through its entire length for the firing-pin, and has a handle, *h g*, by which it is turned and locked in its mortise in the receiver in the usual way of guns of this class. The head of the bolt or nose-piece which supports the cartridge is a separate piece, *n r*, *n r*. It is perforated for the point of the firing-pin and is secured to the bolt by the cross-key *g*. The rear portion of the bolt is of smaller diameter than the body or forward part, and is covered by the thumb-piece *s*, to which the firing-pin is attached by the small screw *p*, which passes transversely through the tenon of the pin. The end of the thumb-piece is terminated by a milled head or finger-piece. On the upper side of the thumb-piece is the fin *k*, which projects into a longitudinal slot in the rear portion of the breech-bolt. The forward end of this slot is inclined to the axis of the bolt which acts on the fin, so as to withdraw the point of the firing-pin slightly within the face of the nose-piece. This movement takes place when the handle *h g* is raised to unlock the breech-bolt, and the point remains in the withdrawn position until the breech-block is again locked, the object being to prevent a discharge before the breech-block is locked. On the under side of the thumb-piece is a rib which works in a slot in the receiver to prevent it from turning with the breech-bolt. In this rib are cut two notches, the hooked safety-notch *r* and the square full-cock notch *r'*. The sear, the nose of which fits into these notches, is of hooked form, as shown in *a s*. The trigger is a bent lever, *a z*, and the point of its short arm fits into the hook of the sear. The cartridge-shell ejector *m* is pivoted on the same pin (*i*) with the sear. Besides ejecting the empty shell from the receiver, this ejector serves the purpose of a stop for the breech-bolt, and this it does by the projection of the shoulder (*n*) into the recess of the breech-bolt above it. The nose of the sear is pressed upward by the flat trigger-spring *l;* the ejector is also pressed upward by the flat spring (ejector-spring) *l'*. Both of these springs are fastened to the receiver by the screw *d*. To withdraw the breech-bolt from the receiver, it is only necessary to free the point of the ejector from its recess by pressing it downward with the thumb. The spring *l'* is extended forward of the screw *d* in such a manner that its head *f* forms an inclined plane to guide the point of the cartridge into the chamber *c*.

The shell-extractor *e* lies in a longitudinal hole above the firing-pin. Its forward end has two inclined surfaces, which, pressing on each other, cause the point to ride over the rim of the cartridge. While riding over the rim it moves slightly backward; after it has surmounted the rim, a spiral spring, *u*, called the extractor-spring, pushes the extractor forward so as to grasp the rim. The hold on the rim is made firm by the pressure of the inclined surface of the point of the keeper-screw *o* on the inclined surface of the top of the extractor.

The firing-pin *n b* is divided into its tenon, which is inserted into a mortise in the thumb-piece; the body, which is surrounded by the spiral main spring; the shoulder, against which the main presses; and the point in front of the shoulder.

The following are some of the principal dimensions, viz:

Diameter of bore, (caliber)	0.42 inch.
Length of barrel	30.43 inches.
Total length of arm without bayonet	50.38 inches.
Total length of arm with bayonet	70.38 inches.
Number of grooves	6
Depth of grooves	0.1 inch.
Twist, one turn in	20 inches.
Weight of arm with bayonet	9.75 pounds.

The cross-section of the blade of the bayonet is quadrangular.

The cartridge for the new Russian rifle is shown in the accompanying Fig. 108 *a*, (full size.) The shell is drawn out of sheet-brass, is made of "bottle shape," and has an outside Berdan primer. The bullet is patched with bank note paper, and there is a lubricating-wad between the powder and the bullet. This wad is a cup of paper filled with stearine, or a substance composed for the most part of stearine. The point of the bullet as far as the cartridge-case is dipped in the same lubricant, melted. The grains of the powder are rounded, the size very uniform, and somewhat larger than that of American musket-powder. The metallic ammunition for small-arms is made in workshops in St. Petersburg and its neighborhood. The several shops were visited by the board and the operations carefully examined. For the most part the process of manufacturing metallic cartridges for the Russian service is the same as that pursued in the United States, and especially at the Union Metallic Cartridge Company, Bridgeport, Conn. The machines were made in the United States, and at first were run by a few skilled American mechanics, to put them in successful operation. These mechanics have returned to the United States and their places have been supplied by native workmen—men and boys—no women being employed in the government cartridge-factories, as in this country. The wages of skilled workmen in the cartridge department is 4 roubles, or $2.80, per day of ten hours; that of laborers, about 1 rouble, or 70 cents. The brass from which cartridge-shells are made is imported from the United States, as thus far none suitable for this kind of work has been produced in Russia. To secure work of the best quality, each shell undergoes twenty-one inspections of material and workmanship in the various stages of manufacture. These inspections, however, are so simple that many of them are done by boys. The cartridge-shells are made in workshops in the city; the bullets are made and the shells are loaded with powder in workshops in the suburbs. The primers are made at the powder-mills. The 0.42-caliber shells are loaded with a Frankford (U. S.) arsenal loading-machine; those of 0.60 caliber, for the altered muskets, are loaded with machines of different construction, the peculiarity of which is that the shell is carried laterally by machinery from the room occupied by the workmen into another room, where it is charged with powder, after which it is returned in the same way, where the bullet is inserted and fastened in.

The bullets are pressed in machines made by Amsler, of Schaffhausen. The lead wire from which the bullets are manufactured is drawn

out in a press, the general arrangement of the parts of which is shown in the accompanying Fig. 109 *b*. The quality of the cartridges is tested by frequent firings. A very ingenious little machine was observed for verifying the weight of the powder in each finished cartridge, viz: The cartridges are placed in grooves in the rim of a vertically revolving wheel, by which means they are deposited, as the wheel revolves, on an arm of a lever, which is adjusted to the true weight of the cartridge; if there is a deficiency of powder in the shell the lever does not move, but the cartridge falls into a receptacle prepared for it; if the powder is of the proper weight, the lever moves and deposits the cartridge in another receptacle It was understood that this machine was made by the Union Metallic Cartridge Company before referred to.

For target practice each soldier is allowed 240 0.42-caliber cartridges per annum, or 140 0.60 caliber cartridges. These numbers include the reprimed and reloaded cartridges, which operations are performed by certain soldiers detailed in each regiment for the purpose.

The only peculiarity observed in the Russian infantry soldier's equipment was the mode of the carrying the cartridge-box by placing it immediately in front of the body.

In some portions of the Russian cavalry—the Cossacks and mounted police—the saber is carried with its cutting edge uppermost to prevent it from being dulled, and for this purpose the rings are applied to the convex edge of the scabbard.

Barrels for small-arms are made of cast steel at the cannon-foundry of Aboukoff; they are forged of full length and then bored out.

Gatling guns, made at Colt's armory, Hartford, Conn., and Smith & Wesson's revolvers, made in Springfield, Mass., have been adopted to a considerable extent in the Russian service. An improved model of the Gatling gun has lately been devised by a Russian officer, in which simplicity of construction and rapidity of fire are the notable features.

SIGHTS.

With the exception of the Prussian infantry sight, the rear sights of nearly all the modern European small-arms are similar in construction to that of the English Enfield rifle-musket. The only exception seems to be the Swiss sight, which operates on the general principle of the gunner's quadrant. The common features of the Enfield class of rear sights are the long base, which is attached in various ways to the barrel, the leaf with its slides, and the strong flat spring attached to the base to keep the leaf in position, either standing up or lying down.

A peculiar feature of this class of sights is that the elevations corresponding to the shorter ranges are obtained by resting the leaf in certain offsets made in the projecting sides of the base. Great attention has been paid in England toward improving the sight of the Martini-Henry rifle. The sight-notch for short distances is made very open. The slide for long distances has a very faint notch in the middle, and two white lines, one on each side of the central notch, and about a tenth of an inch from it. The object of these lines is to assist the marksman in making an allowance for drift and wind.

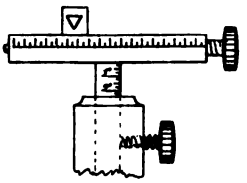
The accompanying plate (110) shows the details of the principal sights, both front and rear, now in use.

The following table gives the length of the stock and position of the rear sight for the principal guns. These dimensions are considered to

have an important effect on the recoil of the gun and the accuracy with which it can be aimed.

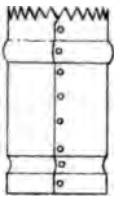
Name of gun.	Distance from center of butt-plate to trigger.	Distance from center of butt-plate to line of rear sight.
	Inches.	*Inches.*
Martini-Henry, (British)	14 and 14½	25
Chassepot, (French)	13½	21½
Werder, (Bavarian)	13½	23½
Mauser, (Prussian)	13½	22
Vetterlin, (Swiss)	12	21½
Russian, (Berdan)	14	21
Werndl, (Austrian)	13	22
Comblain, (Belgian)	13½	22

Fig. 1.



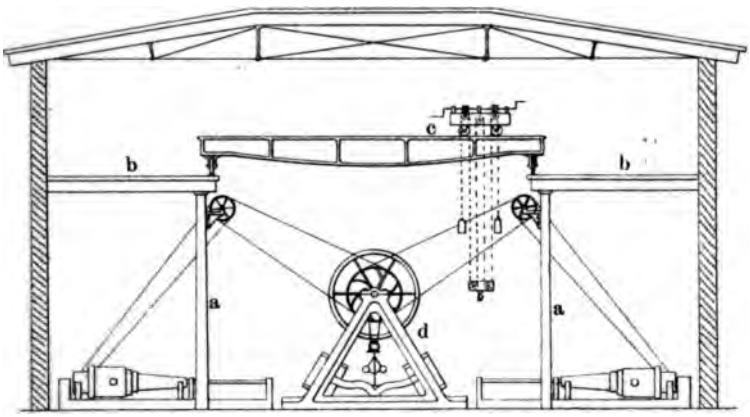
REAR SIGHT FOR FIELD CANNON.

Fig. 2.



CASE FOR FIELD CANISTER SHOT.

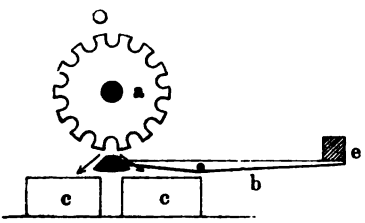
Fig. 4.



CANNON FINISHING SHOP.
ARSENAL ST. PETERSBURG.

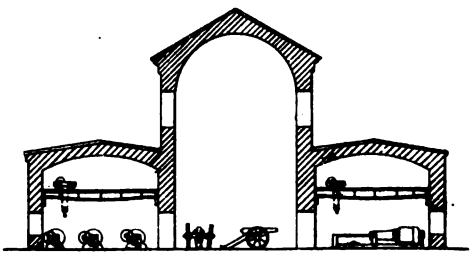
aa. Columns.
bb. Galleries.
c. Traveling Crane.
d. Engine.

Fig. 5.



a. WHEEL WITH CAVITIES IN RIM.
b. LEVER WITH COUNTERPOISE (e.)
c.c. BOXES FOR CARTRIDGES.

Fig. 6.



MAIN WORK SHOP
ARSENAL ST. PETERSBURG.

Accompanying Col. Benton's Report August 1, 1861

vicinity, if practicable, of the greatest importance; and accordingly the board has directed its examination particularly to this section of the country.

"A consideration and examination of the surroundings of New York point conclusively to the immediate north of Newark, N. J., as the section of country possessing the best advantages, and as being most eligible and desirable for locating the proposed arsenal.

"The land here bordering on the Passaic River rises from the level of the river to a height of over 100 feet, and then gradually slopes eastward to the meadow-lands bordering on the Hackensack.

"The character of the ground gives it natural features of defense, and this, added to its location (see Map 1) with respect to important works of defense of New York Harbor, and its freedom from the possibility of naval attack, are considerations of the highest importance.

"The diverging main lines of railroad from Jersey City and Hoboken, at present eleven in number, bring this site in close and rapid communication with New York and the country at large, and the water-facilities of the Passaic and Hackensack are available for transportation of supplies to and from the harbor of the commercial metropolis of our country.

"A special site on this ground has been selected and surveyed, (see report of Mr. H. N. Babcock, marked L",) and is represented in detail on map marked 2.

"Its location with respect to New York City, Newark, and the surrounding country, also with respect to railroad and water means of transit with New York, is shown by the accompanying map, marked 3.

"It will be seen (Map 3) that this site is distant about * * from New York, and about three miles from the suburbs of Newark. It has a frontage on the Passaic of * * * * *, and extending eastward, as it does, from the Passaic River to the Hackensack meadows, it thus has access to both rivers.

"A short line of railroad * * * will connect the site with the railroad system of the country, and at a slight cost of construction, owing to the level character of the adjacent lands.

* * * * * * *

"A suitable proof-ground for ordnance adjoining the arsenal-site is shown on Map 3, and marked (P. G.) * * * It would constitute a valuable adjunct to the arsenal, and it is recommended that it be secured if the site for the latter be approved and purchased.

"The above-recommended purchases do not provide for storage-depots on the waters of New York Harbor, to be especially utilized in times of war. Our recent past experience in the rebellion has shown that such facilities can be readily extemporized when needed from buildings and wharfages already existing for ordinary commercial purposes in New York Harbor, and at a less cost than would be incurred in their permanent provision by the Government.

"It would appear, from the above considerations and facts, that a 'grand arsenal' of construction can be located, at a reasonable and moderate cost, on the Atlantic coast, and at the most desirable point for the concentration of ordnance manufactures.

"In view of this fact, there remains to be considered and determined the proper distribution of the duties of the Department, based upon the early establishment of this arsenal, and the proper disposition of such arsenals as its erection will render no longer needed for the services of the United States.

"The arsenals and armories now established east of the Mississippi River are as follows, to wit:

"Kennebec arsenal, Augusta, Me.
"Watertown arsenal, Watertown, Mass.
"Springfield armory, Springfield, Mass.
"Watervliet arsenal, West Troy, N. Y.
"New York arsenal, Governor's Island, New York Harbor.
"Pikesville arsenal, Pikesville, Md.
"Frankford arsenal, Philadelphia, Pa.
"Washington arsenal, Washington, D. C.
"Fort Monroe arsenal, Old Point Comfort, Va.
"Augusta arsenal, Augusta, Ga.
"Indianapolis arsenal, Indianapolis, Ind.
"Columbus arsenal, Columbus, Ohio.
"Allegheny arsenal, Pittsburgh, Pa.
"Detroit arsenal, Detroit, Mich.

"The principal manufacturing operations of the Department are now performed at the following arsenals, to wit: Watertown, engaged in the production of sea-coast carriages and projectiles for heavy guns; Springfield armory, in the manufacture of small-arms; Watervliet, in the manufacture of leather-work; Frankford arsenal, in small-arm ammunition, and Fort Monroe arsenal, in sea-coast carriages and on experimental duties. The remaining arsenals in the above list are either engaged in small repairs or are simply storage-depots for the care and preservation, issue and receipt, of ordnance and ordnance-stores. It is believed that, except small-arms and small-arm ammunition, the more important ordnance and ordnance-stores, more especially those for field and siege artillery, and those to be provided for the use of our sea-coast defenses, such as cannon, heavy sea-coast carriages, projectiles, and ammunition, and other stores and appliances for their service and maneuver, also harness and the more elaborate articles of leather-work, should all be made at the grand arsenal of construction.

"The manufacture of our small-arms and small-arm ammunition for our present armies and militia, and for our reserve supply, is one of the greatest importance, and as the Springfield armory is a model one of the world in the perfection of its fabrications, and the extent and completeness of its arrangements and facilities for the production of this class of warlike stores, the board regards the retention of this establishment as a foregone conclusion, in its proposed plan for concentration, for the fabrication of its present specialty, and such other work as its facilities may accommodate. Recognizing also the almost imperative necessity, in order to secure perfection in production in the fabrication of small-arms and small-arm ammunition, that they should be produced side by side, the board is of the opinion that arrangements should be made for the transfer of the present manufacturing operations of small-arm cartridges at Frankford arsenal to the Springfield armory as early as it can be accomplished with economy and with a due regard to other important public interests. The more simple leather-work fabrications of infantry and cavalry accouterments, and perhaps some other kinds, all demanded in quantity, and requiring little but no special appliances for their manufacture, can, it is thought, be economically and judiciously made at one of our present arsenals. The board recommends the retention of the Frankford arsenal for this purpose. Its geographical position and its facilities of shops and store-houses and for material and labor of the kind required, its means of transit, and its close and quick connection with the proposed grand arsenal at Newark, N. J., point

conclusively to its retention for the purpose suggested, and as part of the proposed plan for concentration.

"It will be seen that the design contemplated by the board is to concentrate all the principal manufacturing operations of the Department at the proposed grand arsenal, the Springfield armory, and at Frankford arsenal.

"It remains now to designate those arsenals which it is proposed shall be retained to meet the wants of the country as arsenals for storage and repair, and those to be used simply as depots for the care, preservation, receipt, and issue of warlike stores.

"A careful and mature consideration of the question leads the board to recommend the retention of the following arsenals, to wit: Augusta and Fort Monroe as arsenals of storage and repair, and Kennebec, New York, and Indianapolis arsenals as depots for storage and issue. This will leave to be sold the Watertown, Watervliet, Pikesville, Washington, Allegheny, Columbus, and Detroit arsenals.

"The reasons for the retention of the above arsenals, as recommended by the board, are as follows, to wit:

"*Augusta arsenal.*—This is the only arsenal left in the entire South, east of the Mississippi, and the nearest constructing arsenal to it in the proposed plan will be nearly eight hundred miles distant. Its retention and improvement and sufficient enlargement to render it adequate to supply the needs of the Department in the South, in the opinion of the board, is a matter of wisdom, and in fact a necessity. The proposed improvements and enlargement (see memorandum letter of board addressed to Captain Hill, March 7, 1874, official copy of which was sent to that officer March 16, 1874, and the report of that officer dated March 16, 1874) can be secured at a moderate cost. Its present workshops and buildings are in excellent condition, and are sufficiently large in plan to be utilized almost without cost in the remodeling of the arsenal as one for storage and repair. The location, inland, is one of the best in the South, both geographically and in its rail and water facilities, for the reception and distribution of supplies for the South. These and its other advantages for the purposes required, (see Captain Hill's report,) and its general healthfulness, further confirm the board in its opinion as to the propriety and necessity of retention of the Augusta arsenal. Its general plan and its location with respect to Augusta City are given in the accompanying map marked 4.

"*Fort Monroe arsenal, Virginia.*—This arsenal is situated on a Government reservation, and its connection with Fort Monroe renders its sale impossible. It is well provided with shops and machinery, and is admirably situated geographically on the waters of Hampton Roads for fitting out expeditions, as was shown in the late war.

"The arsenal as it now exists, however, is considerably scattered over the Government reservation, and, as a matter of economy and efficiency, it is recommended by the board that all the arsenal property inside the fort, consisting of quarters, barracks, and office, be turned over to the garrison of Fort Monroe. The store-houses and other temporary buildings should be torn down and the materials applied, as far as practicable, to the erection of suitable structures, rendered necessary by this action, outside the fort in the vicinity of its shops. The necessary buildings required to be erected by this plan would cost but little additional to the value of the material obtained by the removal of the store-houses and buildings inside the fort. The buildings inside the fort should not be abandoned or turned over until their places are supplied by suitable structures contemplated to be erected outside the fort.

"*Kennebec arsenal.*—This arsenal is situated on our northeastern frontier, bordering on Canada, is well located, has the requisite facilities, and is deemed necessary for retention to supply the present and prospective wants of that section of our country.

"*New York arsenal.*—This arsenal, located on the glacis-slope of Fort Columbus, Governor's Island, is not available for sale. While incapable of and having no manufacturing facilities, yet it has compraratively extensive storage capacity and wharfage, and superior facilities, from its location in New York Harbor, for the distribution of supplies, and will thus form a valuable adjunct for storage in connection with the proposed grand arsenal.

"*Indianapolis arsenal.*—The construction of a large arsenal on the Atlantic coast and the disestablishment of the interior ones—Allegheny and Columbus—will leave, it is believed, too great an area of country between the Atlantic coast and the Rock Island arsenal (the proposed arsenal and armory of the valley of the Mississippi) unprovided with an ordnance depot, and hence the board recommend the retention of the Indianapolis arsenal as one for storage and issue to meet the wants of the northern lake frontier and the central portion of our country lying to the immediate west of the Atlantic States. Indianapolis is a great railroad center; its other facilities are prominent, and the present arsenal at this point has, in its substantial and capacious store-houses and other advantages, all that is needed for the purpose required.

"In order to inaugurate this general plan for concentration, the board recommend that Congress be asked to make the necessary appropriations for the immediate purchase of the site for the grand arsenal proposed, and for the erection of suitable buildings immediately required thereon, and to enact a law authorizing the sale of the arsenals above designated.

"The arsenals that can be soon prepared for disposition are Washington, Allegheny, Columbus, Detroit, and Pikesville. The following arsenals should be disposed of at such times as the stores now manufactured at them can be provided for at the grand arsenal, viz: Watertown arsenal, Massachusetts, and Watervliet arsenal, New York. It is apparent that no sales should be made until the Department is fully prepared elsewhere to replace the facilities lost by the disposal of any of our arsenals.

"It is evident that any judicious plan for the disposition of even those arsenals most available at present for sale, under the above proposed arrangement of the ordnance facilities for the United States, would require two or three years for consummation, and hence the necessity of appropriations by Congress to secure the site for the contemplated 'grand arsenal,' and its preparation for buildings; the erection of some, and the making of improvements required at its initiation, cannot but be apparent.

"It should be provided by law that the net proceeds of all sales of our arsenals should be used in building up the 'grand arsenal.' The present estimated cost of the arsenal-site and adjacent proof-ground is $262,275.

"To purchase this site and to provide for improvements and buildings which should and can be provided during the first year, it is recommended that Congress be asked at its next session for an appropriation adequate to secure the site and proof-ground, and an additional sum, not exceeding $500,000, for such improvements and structures as the Department may deem best and most expedient to at first provide.

"The accompanying statement, prepared from the reports of the com-

manding officers, appended, marked AA, shows an estimated return from the sale of those arsenals which can be most readily prepared for disposition at present, (if the proposed plan is adopted,) in the aggregate of $2,109,590.56, and that the proceeds of the two remaining ones, Watertown and Watervliet, whose disposition must be at least delayed until they are fully superseded by the proposed new arsenal, will be $1,414,237. Valuable machinery now on hand at the arsenals recommended to be sold and dismantled can be utilized at the 'grand arsenal.' The grand aggregate resulting from the contemplated sales will be $3,526,827.56. This amount will undoubtedly go far toward, if not be entirely adequate for, the full accomplishment of the contemplated concentration of our ordnance manufactures and facilities, and at a point whose superior local, geographical, and other advantages seem to demand centralization; and when we consider the undoubted improvements to be attained, the ease with which they can be secured, and the prospectively small outlay required, it is believed that sound judgment and a wise economy will point to the importance of an early accomplishment of this proposed distribution of the duties of the Ordnance Department of the United States."

No material changes in the values of grounds, buildings, or other appointments of our arsenals have occurred since the date of the above-quoted report, and the status remains the same, save that the Columbus and Detroit arsenals have passed from the control of the Department, the former having been turned over to the recruiting service, and the latter to the Department of the Interior. This leaves the arsenals and armories east of the Mississippi as follows:

Kennebec arsenal, Augusta, Me.
Watertown arsenal, Watertown, Mass.
Springfield armory, Springfield, Mass.
Watervliet arsenal, West Troy, N. Y.
New York arsenal, Governor's Island, N. Y. H.
Pikesville arsenal, Pikesville, Md.
Frankford arsenal, Philadelphia, Pa.
Washington arsenal, Washington, D. C.
Fort Monroe arsenal, Old Point Comfort, Va.
Augusta arsenal, Augusta, Ga.
Indianapolis arsenal, Indianapolis, Ind.
Allegheny arsenal, Pittsburgh, Pa.

The present absolute needs of the service demand, in the judgment of the board, all the manufacturing facilities of the Springfield armory, Frankford, Watervliet, Watertown, and Fort Monroe arsenals, for the production of warlike stores, and the remaining ones, Kennebec, New York, Washington, Augusta, Indianapolis, and Allegheny, are required for their present uses, to wit, care and preservation, issue and receipt, and repair of ordnance and ordnance stores.

It will be seen that but one arsenal (Pikesville) remains as not necessary for the wants of the Department. Its estimated value is $46,635. It should be sold.

The board, from the above, therefore, deems the retention of all our arsenals east of the Mississippi, except Pikesville, as essential for the necessities and proper service of the Ordnance Department, and strongly recommends that no other arsenal be disposed of by sale or otherwise unless it becomes feasible, by congressional legislation, to carry out the plan of concentration in the manner proposed by plan No. 1 of the report of the board on arsenals of 1874. In concluding this report, the board concurring to the fullest extent in plan No. 1 of the report of

the board on arsenals of 1874, would earnestly urge on the Department the wisdom and economy of the concentration of ordnance manufactures and other facilities as proposed by that plan, and recommends its favorable indorsement by the proper authorities for congressional action.

OPINIONS AND RECOMMENDATIONS OF THE BOARD.

Rome, Ga., as a proposed site for a United States arsenal for the South:

The geographical position of the mountainous region of Northwestern Georgia, the general healthfulness of this part of the South, and its great natural advantages in mineral wealth and agricultural resources, render this section of our country prominent for the location of sites for manufacturing purposes, especially those devoted to such fabrications as are needed for ordnance uses.

Rome, well located at the confluence of Oostenaula and Etowah, forming the Coosa branch of the Alabama, has a well-developed railroad system connecting it with the great trunk-roads of the United States, and, by the contemplated improvements of its water-courses, can be connected by this mode of transit with the Gulf of Mexico. The resources of the immediate surrounding country in iron-ores, and the means of its reduction into charcoal-pig; its agricultural and manufacturing advantages; its availability in sites for work-shops and other essential features for an industrial establishment, are additional elements in its favor.

While, however, acknowledging its merits in the above regards, yet its geographical position, and rail and water communications—prime and essential features in location—are, in the opinion of the board, inferior to those of the Augusta arsenal, Ga. The latter being already located and provided with suitable buildings, has all the prime requisites for a southern arsenal for storage and repairs, and the board cannot, therefore, favorably recommend, at this present juncture, its abandonment and the provision of a new arsenal at Rome, Ga.

S. CRISPIN,
Bvt. Col. U. S. A., Lt. Col. Ordnance, President of the Board.
T. J. TREADWELL,
Major of Ordnance.
T. G. BAYLOR,
Major of Ordnance, Recorder.

OPINIONS AND RECOMMENDATIONS OF THE BOARD OF OFFICERS CONVENED BY ORDERS OF THE CHIEF OF ORDNANCE, DATED NOVEMBER 12, 1873.

* * * * * * *

"On the best method of concentrating the manufacturing operations of this Department east of the Mississippi River, either by the establishment of a grand arsenal on the Atlantic seaboard or the enlargement of and concentration of work in one or more of our arsenals, discontinuing the remainder of the arsenals, or retaining one or more as mere places of deposit."

PLAN 1.

"The Ordnance Department, for nearly the last thirty years, in the performance of the various duties intrusted to it by law under the Sec-

retary of War, in the manufacture and procurement of all ordnance and ordnance-stores for armies called into the field at different times during this period; also, in the providing of warlike stores for the prospective wants of future armies, the armaments and material for sea-coast defenses, the material for arming and equipping the militia, and the performance of the important experimental duties intrusted to its care, has experienced during this period more or less serious embarrassment, not only from the inadequacy of existing facilities at the present arsenals of construction, but from their locations and limited resources, necessitating the conduction of the manufacturing operations at different points, widely separated, and being more or less objectionable on account of transportation, procurement of labor and material, and at the loss of the evident economy of a judicious concentration of ordnance manufactures.

"Our present arsenals of construction, located between the Mississippi River and Atlantic Ocean, are widely scattered from Maine to Georgia. This policy of location was necessary at the time of their establishment, when but few, if any, railroad means of transit existed in our country, and when it was important, from this cause, that equipment of troops should be made at or near the localities where raised.

"But at the present day, when our elaborate and perfected railroad and telegraph systems of communication have rendered the question of distance one of but secondary importance, we can now take advantage of these improvements, and subserve the true interests of economy, perfect our products, and attain the other manifest advantages of a policy of centralization by a concentration at one grand arsenal of the most important manufacturing operations in the Department.

"The great importance of carrying out this policy at a 'grand arsenal on the Atlantic seaboard' has been fully recognized and urged in the report of the Chief of Ordnance of December 3, 1862, and repeatedly pressed upon the notice of the War Department, and the action of Congress earnestly recommended, in the subsequent annual reports of this office from 1869 to 1873.

"The first consideration in the location of an arsenal of construction, to effect these ends, is, evidently, that it should occupy a comparatively central geographical position with respect to the Atlantic seaboard, and have at command the facilities of one of our great commercial centers.

"The pre-eminence of the city of New York, in its gigantic means for transit and for prompt distribution of all warlike stores to all points of the United States, its unsurpassed resources in labor and material, and its advantages in a geographical point of view over any city on our coast as a distributing point, renders the location of an arsenal-site in its vicinity, if practicable, of the greatest importance; and, accordingly, the board has directed its examination particularly to this section of the country.

"A consideration and examination of the surroundings of New York point conclusively to the immediate north of Newark, N. J., as the section of country possessing the best advantages, and as being most eligible and desirable for locating the proposed arsenal.

"The land here, bordering on the Passaic River, rises from the level of the river to a height of over 100 feet, and then gradually slopes eastward to the meadow-lands bordering on the Hackensack.

"The character of the ground gives it natural features of defense, and this, added to its location (see Map 1) with respect to important works of defense of New York Harbor, and its freedom from the possibility of naval attack, are considerations of the highest importance.

"The diverging main lines of railroad from Jersey City and Hoboken,

at present eleven in number, bring this site in close and rapid communication with New York and the country at large, and the water-facilities of the Passaic and Hackensack are available for transportation of supplies to and from the harbor of the commercial metropolis of our country.

"A special site on this ground has been selected and surveyed, (see report of Mr. H. N. Babcock, marked L",) and is represented in detail on map marked 2.

"Its location with respect to New York City, Newark, and the surrounding country, also with respect to railroad and water means of transit with New York, is shown by the accompanying map, marked 3.

"It will be seen (Map 3) that this site is distant about * * * from New York, and about three miles from the suburbs of Newark. It has a frontage on the Passaic of * * * * * , and extending eastward, as it does, from the Passaic River to the Hackensack meadows, it thus has access to both rivers.

"A short line of railroad * * * will connect the site with the railroad system of the country, and at a slight cost of construction, owing to the level character of the adjacent lands.

* * * * * * *

"A suitable proof-ground for ordnance adjoining the arsenal-site is shown on Map 3, and marked (P. G.) * * * It would constitute a valuable adjunct to the arsenal, and it is recommended that it be secured, if the site for the latter be approved and purchased.

"The above-recommended purchases do not provide for storage-depots on the waters of New York Harbor, to be specially utilized in times of war. Our recent past experience in the rebellion has shown that such facilities can be readily extemporized when needed from buildings and wharfages already existing for ordinary commercial purposes in New York Harbor, and at a less cost than would be incurred in their permanent provision by the Government.

"It would appear from the above considerations and facts, that a 'grand arsenal' of construction can be located, at a reasonable and moderate cost, on the Atlantic coast, and at the most desirable point for the concentration of ordnance manufactures.

"In view of this fact, there remains to be considered and determined the proper distribution of the duties of the Department, based upon the early establishment of this arsenal, and the proper disposition of such arsenals as its erection will render no longer needed for the services of the United States.

"The arsenals and armories now established east of the Mississippi River are as follows, to wit:

"Kennebec arsenal, Augusta, Me.
"Watertown arsenal, Watertown, Mass.
"Springfield armory, Springfield, Mass.
"Watervliet arsenal, West Troy, N. Y.
"New York arsenal, Governor's Island, New York Harbor.
"Pikesville arsenal, Pikesville, Md.
"Frankford arsenal, Philadelphia, Pa.
"Washington arsenal, Washington, D. C.
"Fort Monroe arsenal, Old Point Comfort, Va.
"Augusta arsenal, Augusta, Ga.
"Indianapolis arsenal, Indianapolis, Ind.
"Columbus arsenal, Columbus, Ohio.
"Allegheny arsenal, Pittsburgh, Pa.
"Detroit arsenal, Detroit, Mich.

"The principal manufacturing operations of the Department are now performed at the following arsenals, to wit: Watertown, engaged in the production of sea-coast carriages and projectiles for heavy guns; Springfield armory, in the manufacture of small-arms; Watervliet, in the manufacture of leather-work; Frankford arsenal, in small-arm ammunition; and Fort Monroe arsenal, in sea-coast carriages and on experimental duties. The remaining arsenals in the above list are either engaged in small repairs or are simply storage-depots for the care and preservation, issue and receipt, of ordnance and ordnance stores. It is believed that, except small-arms and small-arm ammunition, the more important ordnance and ordnance stores, more especially those for field and siege artillery and those to be provided for the use of our sea-coast defenses, such as cannon, heavy sea-coast carriages, projectiles, and ammunition, and other stores and appliances for their service and maneuver, also harness and the more elaborate articles of leather-work, should all be made at the grand arsenal of construction.

"The manufacture of our small-arms and small-arm ammunition for our present armies and militia, and for our reserve supply, is one of the greatest importance; and as the Springfield armory is a model one of the world in the perfection of its fabrications, and the extent and completeness of its arrangements and facilities for the production of this class of warlike stores, the board regards the retention of this establishment as a foregone conclusion, in its proposed plan for concentration, for the fabrication of its present specialty, and such other work as its facilities may accommodate. Recognizing also the almost imperative necessity, in order to secure perfection in production in the fabrication of small-arms and small-arm ammunition, that they should be produced side by side, the board is of the opinion that arrangements should be made for the transfer of the present manufacturing operations of small-arm cartridges at Frankford arsenal to the Springfield armory as early as it can be accomplished with economy and with a due regard to other important public interests. The more simple leather-work fabrications of infantry and cavalry accouterments, and perhaps some other kinds, all demanded in quantity, and requiring little but no special appliances for their manufacture, can, it is thought, be economically and judiciously made at one of our present arsenals. The board recommends the retention of the Frankford arsenal for this purpose. Its geographical position and its facilities of shops and store-houses and for material and labor of the kind required, its means of transit and its close and quick connection with the proposed grand arsenal at Newark, N. J., point conclusively to its retention for the purpose suggested, and as part of the proposed plan for concentration.

"It will be seen that the design contemplated by the board is to concentrate all the principal manufacturing operations of the Department at the proposed grand arsenal, the Springfield armory, and at Frankford arsenal.

"It remains now to designate those arsenals which it is proposed shall be retained to meet the wants of the country as arsenals for storage and repair, and those to be used simply as depots for the care, preservation, receipt, and issue of warlike stores.

"A careful and mature consideration of the question leads the board to recommend the retention of the following arsenals, to wit: Augusta and Fort Monroe as arsenals of storage and repair, and Kennebec, New York, and Indianapolis arsenals as depots for storage and issue. This will leave to be sold the Watertown, Watervliet, Pikesville, Washington, Allegheny, Columbus, and Detroit arsenals.

"The reasons for the retention of the above arsenals, as recommended by the board, are as follows, to wit:

"*Augusta arsenal.*—This is the only arsenal left in the entire South, east of the Mississippi, and the nearest constructing arsenal to it in the proposed plan will be nearly eight hundred miles distant. Its retention and improvement, and sufficient enlargement to render it adequate to supply the needs of the Department in the South, in the opinion of the board, is a matter of wisdom and in fact a necessity. The proposed improvements and enlargement (see memorandum letter of board addressed to Captain Hill, March 7, 1874, official copy of which was sent to that officer March 16, 1874, and the report of that officer, dated March 16, 1874) can be secured at a moderate cost. Its present workshops and buildings are in excellent condition, are sufficiently large in plan to be utilized almost without cost in the remodeling of the arsenal as one for storage and repair. The location, inland, is one of the best in the South, both geographically and in its rail and water facilities, for the reception and distribution of supplies for the South. These and its other advantages for the purposes required, (see Captain Hill's report,) and its general healthfulness, further confirm the board in its opinion as to the propriety and necessity of retention of the Augusta arsenal. Its general plan and its location with respect to Augusta City is given in the accompanying map, marked 4.

"*Fort Monroe arsenal, Virginia.*—This arsenal is located on a Government reservation, and its connection with Fort Monroe renders its sale impossible. It is well provided with shops and machinery, and is admirably situated geographically on the waters of Hampton Roads for fitting out expeditions, as was shown in the late war.

"The arsenal as it now exists, however, is considerably scattered over the Government reservation, and as a matter of economy and efficiency it is recommended by the board that all the arsenal property inside the fort, consisting of quarters, barracks, and office, be turned over to the garrison of Fort Monroe. The store-houses and other temporary buildings should be torn down and the materials applied, as far as practicable, to the erection of suitable structures rendered necessary by this action, outside the fort in the vicinity of its shops. The necessary buildings required to be erected by this plan would cost but little additional to the value of the material obtained by the removal of the store-houses and buildings inside the fort. The buildings inside the fort should not be abandoned or turned over until their places are supplied by suitable structures contemplated to be erected outside the fort.

"*Kennebec arsenal.*—This arsenal is situated on our northeastern frontier, bordering on Canada, is well located, has the requisite facilities, and is deemed necessary for retention to supply the present and prospective wants of that section of our country.

"*New York arsenal.*—This arsenal, located on the glacis-slope of Fort Columbus, Governor's Island, is not available for sale. While incapable of and having no manufacturing facilities, yet it has comparatively extensive storage capacity and wharfage, and superior facilities, from its location in New York Harbor, for the distribution of supplies, and will thus form a valuable adjunct for storage in connection with the proposed grand arsenal.

"*Indianapolis arsenal.*—The construction of a large arsenal on the Atlantic coast and the disestablishment of the interior ones—Allegheny and Columbus—will leave, it is believed, too great an area of country between the Atlantic coast and the Rock Island arsenal (the proposed arsenal and armory of the valley of the Mississippi) unprovided with

an ordnance-depot, and hence the board recommend the 'retention' of the Indianapolis arsenal as one for storage and issue to meet the wants of the northern-lake frontier and the central portion of our country lying to the immediate west of the Atlantic States. Indianapolis is a great railroad center; its other facilities are prominent, and the present arsenal at this point has in its substantial and capacious store-houses and other advantages all that is needed for the purpose required.

"In order to inaugurate this general plan for concentration the board recommend that Congress be asked to make the necessary appropriations for the immediate purchase of the site for the grand arsenal proposed, and for the erection of suitable buildings immediately required thereon, and to enact a law authorizing the sale of the arsenals above designated.

"The arsenals that can be soon prepared for disposition are Washington, Allegheny, Columbus, Detroit, and Pikesville. The following arsenals should be disposed of at such times as the stores now manufactured at them can be provided for at the grand arsenal, viz: Watertown arsenal, Massachusetts, and Watervliet arsenal, New York. It is apparent that no sales should be made until the Department is fully prepared elsewhere to replace the facilities lost by the disposal of any of our arsenals.

"It is evident that any judicious plan for the disposition of even those arsenals most available at present for sale, under the above-proposed arrangement of the ordnance facilities for the United States, would require two or three years for consummation, and hence the necessity of appropriations by Congress to secure the site for the contemplated 'grand arsenal,' and its preparation for buildings; the erection of some, and the making of improvements required at its initiation, cannot but be apparent.

"It should be provided by law that the net proceeds of all sales of our arsenals should be used in building up the 'grand arsenal.' The present estimated cost of the arsenal-site and adjacent proof-ground is $262,275.

"To purchase this site and to provide for improvements and buildings which should and can be provided during the first year, it is recommended that Congress be asked at its next session for an appropriation adequate to secure the site and proof-ground, and an additional sum, not exceeding $500,000, for such improvements and structures as the Department may deem best and most expedient to at first provide.

"The accompanying statement, prepared from the reports of the commanding officers, appended, marked "AA," shows an estimated return from the sale of those arsenals which can be most readily prepared for disposition at present, (if the proposed plan is adopted,) in the aggregate of $2,109,590.56, and that the proceeds of the two remaining ones, Watertown and Watervliet, whose disposition must be at least delayed until they are fully superseded by the proposed new arsenal, will be $1,414,237. Valuable machinery now on hand at the arsenals recommended to be sold and dismantled can be utilized at the 'grand arsenal.' The grand aggregate resulting from the contemplated sales will be $3,526,827.56. This amount will undoubtedly go far toward, if not be entirely adequate for, the full accomplishment of the contemplated concentration of our ordnance manufactures and facilities, and at a point whose superior local, geographical, and other advantages seem to demand centralization; and when we consider the undoubted improvements to be attained, the ease with which they can be secured, and the prospectively small outlay required, it is believed that sound judgment

and a wise economy will point to the importance of an early accomplishment of this proposed distribution of the duties of the Ordnance Department of the United States.

"PLAN 2.

"While the board is unanimous in the opinion that the foregoing plan will in the best and most satisfactory manner economize and perfect the manufactures of the Department, and otherwise provide for its wants east of the Mississippi, yet it feels called upon, under the orders convening it, to submit another arrangement for concentration, based upon the extension of the grounds and the enlargement of the manufacturing and storage facilities of one of our large arsenals of construction, in lieu of the establishment of a new one.

"The board finds this a difficult, if not impossible, problem to satisfactorily solve, owing to the want of a decided pre-eminence in the important essentials requisite at any one of our present arsenals of construction. The one best adapted for this purpose and possessing greater advantages than any other, from its central geographical position with respect to the Atlantic coast, (see map marked 'No. 23,') easy and ready procurement of labor and material, and from its facilities for storage, transportation, and distribution of its products, is the Frankford arsenal. Its enlargement is practicable, as the adjoining farms (see appended map, marked '5,' and report of the commanding officer) can be purchased.

* * * * * * *

"The water-frontage of Frankford arsenal on the Delaware can be made available for transportation, and the grounds can be readily connected by rail with the great railroad systems of our country.

"Its geographical position is by no means as acceptable as the proposed site near New York City, and its extension would not in the highest degree provide for our wants; but yet it is the only establishment for the purpose that the board can in its judgment point to as entitled to consideration, with the view to enlargement and modification, to supply the place of a new grand arsenal of construction.

"In the event, however, of its contemplated enlargement, the board recommends that the Springfield armory, in addition to its present uses and the manufacture of small-arm ammunition, have also transferred to it the manufacture of that class of leather-work contemplated in the first plan to be fabricated at Frankford arsenal.

"This arrangement, as no other changes in the first plan proposed by the board are deemed advantageous, would leave, after the disposition of the arsenals heretofore recommended to be sold, the ordnance duties of the country to be performed at the following arsenals and armories, viz:

"First. Frankford arsenal, Springfield armory—arsenal and armory of construction.

"Second. Fort Monroe arsenal, Augusta arsenal—arsenals for storage, issue, and repair.

"Third. Kennebec arsenal, New York arsenal, and Indianapolis arsenal—arsenals for storage and issue.

"In concluding this part of the report, the board feels called upon to state that this second plan, in its judgment, offers no considerable advantages even on the score of economy; and, therefore, it feels constrained not to recommend its adoption unless it is impracticable to carry out the first plan or its equivalent.

"The accompanying maps, marked from 4 to 17, show the extent of

the grounds and location of the buildings at our present arsenals east of the Mississippi. The geographical positions of the arsenals and their rail and water communications are shown on map No. 24.

"POWDER-DEPOT SITES.

"The essential requisites for a powder-depot site are fully set forth in the instructions of the Chief of Ordnance to the board convened at New York City, dated October 6, 1866, to wit:

"'In selecting sites for these two depots, the following considerations must be observed:

"'1st. The depots should be in a region of country which does not admit of being densely populated, so that the destruction of life and property by accidental explosions would be as small as possible.

"'2d. They should be of sufficient extent to contain in suitable positions magazines to store not less than 10,000 tons of powder for the depot near New York, and not less than 6,000 tons for the other depot.

"'3d. They should be near to a principal railroad, that they may be readily connected with it by a railroad belonging to the Government, and at a point where transportation can be had with facility at all seasons to all points on the seaboard, to the interior, and to the lake frontier.'

"The board, although deeming it of the first importance that the powder-depot should be established near the contemplated grand arsenal of construction, yet in its surveys due attention was paid to important local particulars.

"The vicinity of New York, on the line of the Erie Railroad, it was known from the surveys of the board of 1866, could not only furnish sites in every way desirable for the proposed depot, but the best attainable in the country.

"The board made not only the surveys made by the board of 1866, but also additional ones.

"The special particulars of the sites selected to choose from are given in the accompanying maps marked from — to —, and their relative positions to the proposed grand arsenal are given in the accompanying map marked —.

"Regarding this subject, the board (concurring in the opinion and facts therein set forth) quote the following from the report of the board of 1866:

"'The location of a site for the depot to be established in the vicinity of New York City was deemed to be the first subject for consideration, and preliminary examinations of the most approved local maps—containing in minute detail the topographical features of the surrounding country and the different converging lines of railroad to New York—were made, and detailed inquiries instituted among parties possessing accurate and special knowledge of the characters of *special localities*.

"'A combination of immediate water and railroad facilities for transportation was regarded as a desideratum, but this condition, it was found, could not be fulfilled near New York without sacrificing the more important requirements of a site as set forth in the instructions of the Department.

"'The results of the preliminary inquiries and examinations of the board pointed decidedly and clearly to the valley of the Ramapo River, between the town of Sufferns, N. Y., and Turner's Station, N. Y., along the line of the Erie Railroad, and distant from New York from thirty-two to fifty miles, as the only general locality which had all the prime

requisites, and would in all probability furnish the desired site. (See map No. 18.) A *detailed examination* on the part of the board of this tract of country—extending from Sufferns to Turner's—was made. The general topographical features of this part of the Ramapo Valley were found to be hills on either side varying from 100 to 500 feet in height (the terminating slopes of the Taconic range) skirting the narrow bottom-lands on which the Erie Railroad is located, and here and there broken by narrow ravines diverging at different angles from the valley, and at intervals interrupted by broader ones, on some of which are located the small villages of Ramapo and Sloatsburgh, and the hamlet of Southfields. In rear of these heights the country is broken by narrow ravines parallel to the valley and walled in by the opposite hills.

"'These superior natural features for our purposes, with the absence of inhabitants and of arable grounds for cultivation and support of a dense population, determined the question as far as general location was concerned, and the special examinations made led to the selection of a tract which, it is believed, will afford an excellent site, and one which we can specially recommend as having every requisite that could be desired, leaving out the advantages of immediate water-transportation. (See map No. 18.) This site is known as the Augusta tract, situated in Orange and Rockland Counties, New York, and owned by Peter Lorillard, esq., of New York City. It is thirty-eight miles from New York, has an area of 4,481 acres, and is traversed by the Erie Railroad along the valley of the Ramapo. (See map No. 1.)

"'That portion of the property west of the Erie Railroad, bounded on the east by the line extending from intersection of the northern line with the railroad southward through "Fox Hill," "High Peak," and "Ant Ridge," and bounded on the west by the property of Mead and Shuet, and on the south and north by the "Sterling estate," has been selected (an area of about 2,500 acres) as the best adapted to our purposes. (See map No. 1.) This portion of the tract is approached by the wood-road intersecting the "Orange turnpike" at the "saw-works," and leading through a narrow valley to the "fish-house," and extending thence along the east shore of Truxedo Lake. A high hill, around the base of which the road winds, guards this approach at the "saw-works."

"'The line of hills skirting the valley of the Ramapo, of which "Fox Hill," "Ant Ridge," "High Peak," and "Iron Mine" are prominent points, and the range bordering on Truxedo Lake and its outlets on the west, form, it will be seen, material barriers on the exterior; and as the intervening or interior ground is broken by ravines, and affords natural traverses between which to locate magazines, we have thus all the natural advantages which could possibly be desired.

"'As the fall from Truxedo Lake along the valley of the outlet is only 80 feet to the saw-works, it will be seen that a railroad to connect with the Erie Railroad at this point can be readily constructed, and thus connect the site with the interior by rail, and with New York City direct by rail, or, via Piermont, by rail or rail and water. The nearest hamlet to this property is Southfields, a wood and water station of the Erie Road, four miles off; the nearest village is Sloatsburgh, two miles below. (See map No. 1.) The ground is rocky, and this, combined with its hilly nature, renders it unsuited for agricultural purposes, for residences, or for manufacturing settlements.'

"The Augusta tract, however, from the present views of the owners, (see letters of Mr. Lorillard, marked 'B" and 'K",') may be too costly to enable the Government to secure it, and the board extended its examination, and selected and had surveyed, as next best and available for

the purpose, the sites shown in detail in the accompanying maps, alluded to heretofore.

"These sites, * * * in the general features of seclusion, character of ground—inclosed by their hilly barriers—ease of connection with the Erie Road, and other essentials, approach the perfection of the Augusta tract sufficiently near to render them available for our purpose, provided the former cannot be secured at a reasonable price. In any event the board deem, from the results of its general surveys, that the securement of a suitable site in this section is a foregone conclusion.

* * * * * * *

"In concluding this part of the report, it is deemed well to allude to the immediate necessities of a suitable powder-depot for the Atlantic coast.

"In the establishment of our present arsenals, as their locations, at the time of their construction, were but sparsely settled, the erection of powder-magazines on these Government reservations provided for our wants in this respect. The rapid increase of population in the adjacent towns and cities has, however, in the majority of cases, rendered these magazines dangerous to the communities in which they are located, and hence the Government either has abandoned or eventually will have to essentially abandon the storage of powder at all of our arsenals. The damp sea-air renders our fortifications unfitted for this purpose, and the Government has now large quantities of powder rapidly deteriorating at these places for want of proper storage-facilities. About 2,500 tons of powder and 3,000 tons of niter are now on hand.

"The necessity of immediate action is hence deemed, it is believed, apparent, and it is earnestly recommended that Congress be asked at its next session to appropriate a sum adequate to purchase a site, and commence the provision of buildings suitable not only for the storage of powder, but also for our niter supplies, and the accommodation of suitable machinery and appliances for the manufacture of experimental powders.

"EXPERIMENTAL GROUND FOR HEAVY ORDNANCE.

"The Department has long felt the want of a suitable site for testing heavy ordnance, obtaining ranges, and solving the various experimental problems connected with the science of gunnery.

"The report of the Chief of Ordnance of 1872 thus alludes to the entire inadequacy of our present facilities in this regard:

"'It has been compelled to avail itself of the limited extent of ground near Fort Monroe for the prosecution of these important duties. As the artillery-school of practice is established on this reservation, the space is necessarily too contracted for the operation of both. Besides, the range obtained on land is but little more than a mile, and that over the waters of the Chesapeake Bay seldom available; whereas, for efficient experimental purposes, a range of at least six miles is indispensable.

"'Some central point convenient to railroad communication, with a suitable extent of level ground, could be readily selected and purchased at a small cost. Experiments with large ordnance cannot be properly conducted without the best and most approved facilities, such as every military nation has found it necessary to provide.'

"The main features that are essential to such a site are that it should be comparatively level, easily accessible, not traversed by highways or extensive water-courses, uninhabited, and sufficiently remote from any

settlements to avoid any possible accidents, and embracing an extent of land from seven to eight miles in length and from one-half to one mile in width. It is deemed very desirable by the board that this site should not be very remote from the grand arsenal on the Atlantic seaboard, nor from the powder-depot.

"The level beaches and flat interior lands of Long Island and the coast of New Jersey were all, it will be seen by the record, examined.

"The sites examined on Long Island are in the vicinity of Babylon, Deer Park, Bay Shore, and Islip. The ground lies here in extensive level stretches, adapted in this respect for our purposes, but it is deemed objectionable by the frequency of rail and wagon roads, and by the rapidly-increasing settlements, rendering early and serious interference in this regard highly probable.

"The Jersey coast, extending from Sandy Hook to and including Squan and Island Beaches, consists of level and long stretches of sandy beaches, and the upper end of Squan Beach, in the vicinity of the town of Point Pleasant and Squan Village, has the best local advantages found and examined by the board. This ground has been carefully surveyed under the direction of the board, by Mr. H. N. Babcock, (see his report, marked 'M',') and a site selected. (See map marked '21.')

* * * * * * *

"The contemplated rail-connection would be about two and one-half miles, and its construction would not require any extensive excavation or filling in, and hence it can be built at a moderate cost.

"The relative location of this site to the grand arsenal and the proposed powder-depot is shown on the accompanying map marked 'No. 1.' An examination of this map will show that ample rail facilities connect this section of the country with the country at large. The present United States life-saving and signal stations located on the beach, it is believed, will be advantageous to our use of this ground for experimental purposes, while our occupancy will not interfere with these other branches of the public service. The meteorological phenomena of this portion of the coast, such as the force, direction, and frequency of winds and occurrence of fogs, have not yet been fully determined, but all the information in this regard which the board could obtain is presented in the accompanying reports.

"While this site does not possess in the highest degree all the desired requisites, still it is believed to be the best that can be found on the Atlantic coast within a convenient and desirable distance from New York City, the proposed grand arsenal and the depot for powder.

"The purchase of this site, building the proposed railroad, and purchase of right of way, the erection of the necessary buildings, and improvement of the ground, it is thought, will not exceed $100,000, and it is earnestly recommended by the board that Congress be urged to make the necessary appropriations at its next session.

"The Government reservation at Sandy Hook, (see map marked 'No. 22,') at the entrance of the harbor of New York, distant eighteen miles from the city, and in close and quick communication with it, has an available extent in length of, say, one to two miles, and in breadth of, say, three-fifths of a mile. Its general features are the same as Squan Beach, but it is entirely too contracted for all our uses, and the Long Branch Railroad limits and materially interferes with its usefulness as an experimental firing-ground. However, it is superior in geographical location and equal in other respects to our present facilities at Fort Monroe, and in the interim of the establishment of the experimental ground at Squan Beach it could be utilized, (with the permission of the

Engineer Department,) as an adjunct with Fort Munroe, for carrying on such experiments and proof as it may be fitted for and as may be deemed desirable to have conducted at this point.

"S. CRISPIN,
"*Bvt. Col. U. S. A., Major of Ordnance, President.*
"T. J. TREADWELL,
"*Major of Ordnance.*
"T. G. BAYLOR,
"*Major of Ordnance, Recorder.*"

NOTE.—The maps and drawings referred to in the foregoing report do not accompany it. They are filed in the office of the Chief of Ordnance.

Statement of the original cost and the estimated market-value of lands, buildings, and improvements at the herein-named United States arsenals east of the Mississippi River.

Name of arsenal.	Original cost of land, buildings, and improvements.			Estimated market-value of lands, &c., as taken from reports of the respective commanding officers.			Remarks.
	Land.	Buildings, &c.	Total amount of cost of land, buildings, &c.	Land.	Buildings, &c.	Total estimated value of lands, buildings, &c.	
Allegheny arsenal ...	$19,383.71	$287,645.00	$307,028.71	$900,000.00	*$71,911.25	$971,911.25	The buildings, in the event of the land being sold in lots, would be of but little more value to the purchasers than for their materials, excepting those in the lower yard for railroad and manufacturing purposes, shops, dwellings, and store-houses.
Pikesville arsenal ...	(†)	Not given	.....	11,935.00	34,700.00	46,635.00	The buildings, if sold without the land, would not bring over $5,000 to $7,000.
Washington arsenal .	118,079.97	619,801.21	737,881.18	(881,044.31)		881,044.31	A board of assessors, appointed by the Secretary of the Interior, in their report, dated March 30, 1872, appraised the lands and buildings at this post at $1,527,850.
Watertown arsenal . .	53,616.13	473,286.63	526,902.76	120,000.00	310,000.00	430,000.00	The amount paid for the purchase of the two first tracts of land is not included in the original cost of the land at this post, as it could not be ascertained from the records of the office. The area of these two purchases is about forty acres. If the sale was forced, the buildings would not bring the price named.
Watervliet arsenal ‡ .	56,769.27	545,620.00	602,389.27	150,000.00	837,234.00	987,234.00	In the event of the land being cut up into lots, some of the buildings would have to be moved from the streets, which would run through the grounds. In the letter, (extract-copy inclosed in letter to board on arsenals, &c., of April 1, 1874, marked "D", to the Hon. John Coburn, chairman of Military Committee House of Representatives,") Col. P. V. Hagner states that he estimates that the reservation, laid out into lots 120 by 50 feet, should be worth about $400,000, excluding buildings.

* This value, being 25 per cent. of the original cost, is placed by the board on arsenals, &c.
† No record of cost on file at the post.
‡ The original cost of buildings and improvements is not given in many instances, hence the apparent difference between the estimated market-value and the original cost.

No. 4.

F

RSENAL

C·RES

Smith Shop
Cisterns (underground)
Sheds
Lumber Shed
Engine House
Shops
Barracks
Officers Quarters
Well
Hospital
Coal House

ON ARSENALS,

ance of Act of Congress
March 3, 1875.

ayne, Report of Board on Arsenals—Appendix M, 1877

of a war to promptly supply all our forts with their complements of sound and suitable powders.

I may mention in this connection that powders kept in our arsenal magazines do not, from our experience, suffer any deterioration, as a rule, other than that incident to years of storage.

In conclusion, I would respectfully invite attention to the following extract from the report of the board on arsenals of 1874:

"In concluding this part of the report, it is deemed well to allude to the immediate necessities of a suitable powder-depot for the Atlantic coast.

"In the establishment of our present arsenals, as their locations at the time of their construction were but sparsely settled, the erection of powder-magazines on these Government reservations provided for our wants in this respect.

"The rapid increase of population in the adjacent towns and cities has, however, in the majoritiy of cases, rendered these magazines dangerous to the communities in which they are located, and hence the Government either has abandoned, or eventually will have to abandon, the storage of powder at all of our arsenals.

"The damp sea-air renders our fortifications unfitted for this purpose, and the Government has now large quantities of powder rapidly deteriorating at these places for want of proper storage facilities. About 2,500 tons of powder and 3,000 tons of niter are now on hand.

"The necessity of immediate action is hence deemed, it is believed, apparent, and it is earnestly recommended that Congress be asked at its next session to appropriate a sum adequate to purchase a site and commence the provision of buildings suitable not only for the storage of powder, but also for our niter supplies, and the accommodation of suitable machinery and appliances for the manufacture of experimental powders."

Very respectfully, your obedient servant,

S. CRISPIN,

Brt. Col. U. S. A., Lieut. Col. of Ordnance, Commanding.

THE CHIEF OF ORDNANCE, U. S. A.,
Washington, D. C.

STATEMENT No. 1.

Memorandum showing the condition of powders stored in undermentioned sea-coast forts, overhauled, and condition ascertained, covering a period of five years, from 1871 *to* 1875, *to wit:*

Year.	Posts.	Cannon.		Mortar.		Musket.		Total.
		Sound.	Damaged.	Sound.	Damaged.	Sound.	Damaged.	
		Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1871..	Fort Pickering, Mass.	200	600	.....	.....	.....	.....	800
1872..	Fort Columbus, N. Y..	53	104	129	378	.....	.....	664
1873..	Fort Warren, Mass ...	1,000	334	900	311	.....	.....	2,545
1875..	Fort Adams, R. I	.....	828	.....	795	.....	.....	1,623
1875..	Fort Schuyler, N. Y ...	307	861	12	221	.....	73	1,474
	Total	1,560	2,727	1,041	1,705	.....	73	7,106

RECAPITULATION.

Total number of barrels overhauled, 7,106; of which 2,601 barrels were serviceable and 4,505 barrels damaged, or 63 per cent.

STATEMENT No. 2.

Statement of the quantities of powder on hand, stored at the arsenals and at the sea-coast forts, during the years 1871 *and* 1875.

	Barrels.
Arsenals, 1871	40,560
Forts, 1871	31,000
Total	71,560
Arsenal, 1875	*17,585
Forts, 1875	30,000
Total	47,585

STATEMENT No. 3.

Estimated cost for the purchase of a site for a powder-depot, the erection of magazines and other buildings, improvement of grounds, and the construction of rail-communications between the depot and the Erie Railroad.

Five magazines, to be constructed of brick, each 200 feet by 50 feet, and 12 feet clear between floors and ceilings, to accommodate 60,000 barrels of powder	$400,000 00
Quarters, stables, and other necessary buildings	75,000 00
For purchase of site of, say, 1,000 acres, at $40 per acre	40,000 00
Constructing wagon-roads, bridges, drains, inclosing fences, and other improvements to ground	60,000 00
Constructing railroad to establish connection between Erie Railroad and the depot, a distance of 2½ miles, at $10,000 per mile	25,000 00
Total	600,000 00

*14,480 barrels are at Saint Louis, Mo., arsenal.

APPENDIX O.

Trial of the Hotchkiss revolving cannon, caliber one and one-half inches.

OFFICE OF THE ORDNANCE BOARD, U. S. A.,
New York City, June 18, 1877.

SIR: I have the honor to transmit herewith the report of "The Ordnance Board" of the trial of the Hotchkiss revolving-cannon, caliber one and one-half inches, made at Sandy Hook, New York Harbor, from September 11, 1876, to February 15, 1877, under your instructions.

Very respectfully, your obedient servant,

S. CRISPIN,
Bvt. Col. U. S. A., Lt. Col. of Ord., President of the Board.

The CHIEF OF ORDNANCE, U. S. A.,
Washington, D. C.

A description of the Hotchkiss revolving cannon.

THE GENERAL SYSTEM.

The Hotchkiss revolving cannon cannot be classed with mitrailleuses in the ordinary sense of the latter term, as explosive shells are fired with the former, and it has a range equal to that of field-artillery.

The system of this gun may be explained as follows:

Five barrels, grouped around a common axis, are revolved in front of a solid breech-block, which has in one part an opening to introduce the cartridges, and another opening through which to extract the empty shells, while the cartridges are fired after being revolved and while motionless in front of the solid portion of the breech.

The exterior aspect of this revolving cannon resembles the Gatling mitrailleuse, it being, on the other hand, entirely different in its interior mechanism.

The system is composed of two distinct parts, viz, the barrels with their disks and shaft, and the frame and breech containing the mechanism.

The five barrels, made of the finest oil-tempered cast steel, are mounted around a common axis, between two disks, on a central shaft. The series of barrels are in this way placed in a rectangular frame, which is attached to the breech, the near end of the shaft penetrating the same to receive the rotary motion from the driving-gear.

The breech itself is composed of a solid cast-iron breech-block, weighing about 386 pounds. This absorbs the greater part of the recoil. It has a door at the rear end, which can be easily opened, so that the mechanism is freely accessible, and can, if necessary, be dismounted and put back into its place in a few minutes, without the aid of any special tools.

A peculiar feature of this gun consists in the barrels remaining *still* during the discharge, so that there is no movement of any kind to impede the accuracy of the fire. This stop or lost motion is obtained by the shape of the driving-worm, which is so constructed that the inclined driving-thread only covers half its circumference, the other half of the thread being straight. The effect of this is that the barrels only re-

volve during half a revolution of the worm, and stand still during the other half revolution. The combination of the mechanism is so arranged that the loading, firing, and extracting takes place during this pause. This feature is of great importance for the accuracy of fire and the durability of the system.

The worm-shaft projects through the breech on the right side, and has a crank with which the whole system is moved; on the left side of the worm-shaft a small crank is attached, by which the loading and extraction of the cartridge-shells is effected in the following manner:

On the interior face of the left side of the breech a cog-wheel is mounted, with two horizontal racks, the one being placed above the other under this cog-wheel, and parallel to the axis of the barrels, so that in moving one of these racks the other is moved by the cog-wheel in the opposite direction. Part of the lower rack forms a vertical slot, in which the small crank on the left side of the worm-shaft works. The rotation of the latter consequently gives an alternating and opposite movement to the two racks, so that while the one is going forward the other moves back, and reciprocally.

The under rack forms the extractor; the upper one moves a piston which drives the cartridge into the barrels, the cartridge being placed before the piston, in the trough in which it moves; and during the time the barrels are motionless it is introduced into the one standing before the trough. The cartridge is not "driven home" entirely, but its head is in view of an inclined plane, cut into the metal of the breech, on which it slides when it is moved by the rotation of the barrels. This completes the introduction of the cartridge into its chamber. The piston itself is a simple cylinder connected with the rack, and running in a slot in the conducting-trough.

When the racks are in their extreme positions they remain still a moment. This stop is obtained by giving the slot in its center part a circular shape concentrically to the shaft of the crank. This is necessary, because at the moment of the barrels arriving at the end of their course the head of the cartridge-case becomes engaged in the hooks of the extractor, which would not be possible if it were in motion at the time.

The extractor is a large double hook at the end of the bottom rack; it is very solid, and its proper working is certain under all circumstances.

After the cartridge is extracted from the barrel it strikes against an ejector, which pushes it out of the extractor, and it falls to the ground through an opening in the under part of the breech. The firing-pin has an elongation, pointing downward, which, by the operation of a spring, is pressed against a cam on the worm, and as the worm rotates, the cam drives the firing-pin back and compresses the spring. The moment the firing-pin becomes liberated, it strikes the primer of the cartridge and the discharge takes place.

To obviate the difficulties which exist in other systems, when the cartridges are piled one upon the other, the opening of the introduction-trough is closed by a little door, which goes down by the weight of the cartridges, the first of which drops into the trough, and then the piston, in moving forward, raises the door and allows no more cartridges to enter until the proper time.

All parts of the mechanism are very strong and durable, and hardly exceed in number those of an ordinary small-arm, there being, besides the group of barrels, thirteen parts, viz:

1, 2. The breech-block, with its door for closing the rear end.

3, 4, 5. The crank-shaft, with its worm for moving the barrels, and small crank for working the loader and extractor.
6. The crank.
7, 8. The firing-pin and spiral spring.
9. The extractor.
10, 11. The loading-piston and rack for moving it.
12. The cog-wheel for transmitting the movement of the extractor to the loading-piston.
13. The door for regulating the feed of cartridges.

The operation of the mechanism, the rapidity of fire, and the number of men to work the gun.

The operation of the mechanism may be described as follows, supposing the crank to be in continual motion:

A cartridge is placed in the introduction-trough, the piston pushes it into the barrel, then the barrels begin to revolve, and the cartridge is carried on till it arrives before the firing-pin, which penetrates the solid part of the breech, and which has in the mean time been retracted by the action of the cam. Then, as soon as the cartridge has arrived into this position, the barrels cease to revolve, and the primer of the cartridge is struck by the firing-pin and discharged; then the revolution of the barrels begins again, and the fired cartridge-shell is carried on until it comes to the extractor; this, in the mean time, has arrived up to the barrels and the cartridge-head rolls into it. As soon as the head is laid hold of by the extractor, the barrels again cease to revolve, and during this period the cartridge-shell is withdrawn and dropped to the ground. As during every stoppage of the barrels the gun is supplied with a new cartridge, and the firing and extraction is also performed, during this time a continuous but slow fire is kept up. By supplying the gun in this manner with single cartridges, about thirty rounds per minute may be fired.

Should rapid firing be required, the gun is then supplied, not with single cartridges, but with "feed-cases," containing groups of ten cartridges each, and in this manner from sixty to eighty rounds per minute can be fired, with only three men to work the gun; viz, one man to train the gun and revolve the crank; one man to place the "feed-cases" containing the cartridges into the "feed-trough;" and a third man at the ammunition-chest to charge the "feed-cases" and to hand them to the charger.

Attached to the frame is a turn-table which connects the cannon to the "trunnion-saddle," arranged in such manner that without displacing the carriage a certain amount of lateral motion as well as of elevation may be given to the gun. Thus the gun is made to sweep horizontally along a line, by adjustment, between each single shot, or during rapid discharge.

THE AMMUNITION.

The ammunition for the revolving cannon consists of a center-fire metallic cartridge of special construction, holding in each one the powder, the projectile, and the lubricating-wad, arranged like the similar ammunition generally used for small-arms.

Two different kinds of projectiles are used, the one an explosive shell and the other a case-shot. Nothing need be said of the latter, as it does not differ from the common case or canister shot used in ordinary cannon.

THE SHELL.

The shell is of a novel construction; it is of cast-iron, of a cylindro-ogival shape, slightly rounded at the rear end. The packing consists of a brass coat of about one caliber in length, and placed equidistantly from the center of gravity. This coat is of soft brass tubing, contracted with great pressure over the body of the projectile, it being provided with longitudinal grooves, and two grooves encircling it at the top and bottom ends of the packing. The coating is forced into these grooves, and any disturbance of it on the body at starting is thus obviated. These grooves serve at the same time as breaking-lines of the shell.

After the coating is attached to the projectile, some small saw-tooth-like grooves are cut into it, to reduce the strain while being forced through the rifling of the barrel. These grooves can be filled with a lubricating substance, and this is then carried perfectly between the projectile and the bore of the barrel.

The coating of the projectile is conical at its front part, corresponding with the cone in the projectile-chamber, so that it is exactly centered in the bore as soon as the forward movement commences. Its rear end is cylindrical to within about one-third of its length.

The shell is turned smooth all over, and is nearly 0″. 016 in diameter less than the bore of the barrel. This projectile is made with great care and exactness, with only a very small deviation in dimension.

THE FUSE.

The fuse employed is that known as the Hotchkiss percussion-fuse, used in large quantities during the last war in America.

It consists of a gun-metal body closed at the front end with a nose-screw, forming the ogival point of the projectile; it has a conical hole at the rear, which is closed with a lead plug, (the safety-plug,) pressed in very tightly, so that the plug projects a little through the base of the body-case toward the inside.

The plunger is composed of lead cast into a brass casing to strengthen it, and to prevent the lead from being upset by the shock of discharge. A brass wire is cast into the lead of the plunger, and holds it suspended in the case, the wire going through the hole in the bottom of the case, and being held securely in position by the safety-plug. The plunger has a nipple cast into the lead, and is formed with an ordinary gun-cap; in its axis it has a powder-chamber containing the igniting-charge.

The operation of the fuse is thus: The safety-plug is dislodged backward into the interior of the projectile by the shock of discharge; the wire then being not held tight in the hole, the plunger is disengaged and rests on the bottom of the fuse-case, and is free to move in the line of axis. When the flight of the projectile is suddenly retarded by its striking any object, the plunger, in consequence of its inertia, is driven forward, and the primer strikes against the nose-screw, thus igniting the powder in the channel, and so firing the bursting-charge of the projectile.

The Hotchkiss percussion-fuse is extremely simple in its construction, and requires no adjustment before use. It is perfectly safe in transport, and during all manipulations with the projectile, as the plunger is held securely by the safety-plug, which must receive the great shock of the discharge to discharge it from its hole, and thus liberate the plunger.

THE CARTRIDGE-CASE.

The cartridge-case consists of a spirally-rolled tube of sheet-brass, strengthened at the head with an inside and an outside cup. The head is punched out of sheet-iron, and is fastened to the cups with three rivets.

The primer consists of a case holding the anvil, and is closed at the bottom end by the cap containing fulminate; it is fitted into a hole which penetrates the head and both cups, and it projects through into the inside of the cartridge-case.

This cartridge, which can be manufactured with great facility on account of its simplicity, has proved itself to be of a very durable quality, and it can be used repeatedly.

The construction of the body of the cartridge allows it to expand to the chamber of the gun without the metal being stretched, so that after the discharge it contracts itself again to its previous diameter, thus leaving the fired case perfectly loose in the chamber for extraction.

THE LUBRICATOR.

The lubricator consists of a wad of felt about 0″.236 thick, dipped in a solution of mixed tallow and beeswax. A paper disk is placed between the lubricating-wad and the charge to prevent the powder getting damaged by the greasy surface of the lubricator.

The projectile is merely pressed into the neck of the cartridge and is not clenched, as there is enough friction to hold it absolutely secure.

Of course the ammunition is, as in the case of all modern small-arm ammunition, which it resembles, rendered safe against influences of weather and danger of explosion.

Principal dimensions and weights, &c., of the gun.

Caliber	1.457 inches.
Total length of bore	4 feet 2.236 inches.
Length of rifling	3 feet 8.882 inches.
Rifling, one turn in	4 feet 1.212 inches.
(Twist and depth of grooves uniform.)	
Number of grooves	12
Width of lands	0.098 inches.
Depth of grooves	0.019 inches.
Number of barrels	5
Diameter of barrel over powder-chamber	3.464 inches.
Diameter of barrel at the muzzle	2.440 inches.
Weight of each barrel	77.166 pounds.
Radius of sights	2′ 3″.047
Vertical distance of the line of sight from the common axis of the barrels	2.0866 inches.
Horizontal distance of the line of sight from the common axis of the barrels	6.496 inches.
Weight of gun	1,047.25 pounds.
Total weight of gun with traversing apparatus	1,157.48 pounds.

Principal dimensions and weights of the ammunition.

EXPLOSIVE SHELL.

Length of body	4.10 inches.
Entire length with fuse	4.71 inches.

Length of brass coating, equidistant from center of gravity	1.5 inches.
Diameter of body	1.44 inches.
Diameter of brass coating	1.49 inches.
Weight of body of the projectile	1 pound 1.4 ounces.
Weight of fuse	3.3 ounces.
Weight of bursting-charge*	0.74 ounce.
Total weight of projectile complete for firing	1 pound 5.58 ounces.

Weights and dimensions taken from shell fired by the board.

CASE-SHOT.

Length of case	4.565 inches.
Exterior diameter of case	1.440 inches.
Number of balls	18
Diameter of each ball	0.62 inches.
Average weight of each ball	1.03 ounces.
Total weight of shot	1 pound 9.4 ounces.

CARTRIDGE-CASE.

Length of cartridge-case	4.724 inches.
Diameter of head	1.791 inches.
Diameter of the body near the head	1.641 inches.
Diameter of body in front	1.476 inches.
Weight of cartridge-case	3.88 ounces.

CHARGE OF POWDER.

Charge	4.23 ounces.
Proportion of charge to weight of projectile	4.33
Weight of complete cartridge	1 pound 10.46 ounces.
Length of complete cartridge	8.149 inches

THE CARRIAGE.

For the revolving cannon a special carriage has been constructed This was found necessary, as the ordinary field-gun carriage is not provided with the means for procuring an excellent and immovable rest for this gun.

The trail of the carriage consists of two brackets of steel plate, connected by three transoms and bolts, the rear end being connected by the trail eye-piece. The brackets diverge against the trunnions.

The trunnion-bearings, and the bearings for the axle-tree, are riveted to the outside of the brackets and are fitted in the ordinary manner.

The axle-tree is of steel, the arms being slightly conical. The wheels have metallic naves and ring-tires. The nave consists of two parts, the inside flange, with the pipe-box, and the outside flange. The spokes are cut in a conical form at their "hub" ends, so that they fill the nave-flanges, and the two parts of the nave are bolted together with the spokes with six screws.

These wheels are very strong, and have been found practical and economical in service, and they allow spokes to be easily substituted for others when broken.

* It would be advisable to use either gun-cotton or picrate-powder for the bursting-charge, as these would throw the fragments forward with more force than ordinary gunpowder, and thus produce a greater destructive effect.

The elevating arrangement consists of a screw working in a gun-metal nut, resting in the oscillating bearing. This nut is revolved by conical gear-wheels from the left side of the trail, the top-end of the screw being attached to the trunnion saddle-plate.

The handspike is hinged to the trail so as to fold back in traveling. A tool-box is placed between the trail; this at the same time makes a solid connection of the trail-brackets.

The carriage of the revolving cannon is usually provided with a light steel shield for the protection of the gunners from small-arms fire.

This shield is of three parts, made to fold together, thus forming seats for two men. It can immediately, when coming into action, be unfolded and only the muzzles of the barrels and the wheels of the carriage are exposed to the enemy. The steel plates are about 0.236 inch in thickness.

Two boxes are attached to the axle-tree, each to carry three feed-cases loaded with ten rounds of ammunition.

On the carriages not provided with a shield these ammunition-boxes are protected by light steel plates in front, and have a lid of steel, which, when raised, forms a small protecting-shield, and when closed they form seats for two gunners, so that with two or three gunners on the limber a sufficient number of men to serve the piece would be taken into action with the gun itself.

To check the recoil of the gun, a brake of the following construction is used:

Each axle-arm has a screw cut on its extremity; this carries a nut forming a conical cap, partly enveloping the front side of the wheel-nave, which is likewise conical, to fit the inside of the cap; this has a short crank, by which it can be revolved on the axle. When screwed up this cap grips the cone of the nave of the wheel, and the tighter the cap is screwed up, so the wheel turns with the more difficulty on its axis, until it gets immovably locked on the axle by the friction of the cones. When the cap is unscrewed, it is disengaged from the wheel, which can then turn freely on the axle. The screws on the ends of the axle-arms have right and left handed threads, so that the caps become tightened by the effect of the recoil.

This brake is used at the same time as an ordinary traveling-brake, and it can be applied without the carriage being stopped, as is necessary with the shoe-brake commonly used on gun-carriages.

Principal dimensions and weights of the carriage.

Weight of carriage, with wheels, ammunition-boxes, and accessories, complete	1,169 pounds.
Weight of steel shield	331 pounds.
Weight of wheels, each	187 pounds.
Diameter of wheels	55 inches.
Weight of trail on the ground	99 pounds.
Weight of trail when hooked on limber-hook	44 pounds.
Track of wheels	59 inches.
Angle of trail with the ground	17° 30′
Height of trunnions above the ground	42 inches.
Extreme angles of elevation and depression	−5°+25°
Greatest angle of dispersion with horizontal training apparatus	3°

THE LIMBER AND THE AMMUNITION-CHEST.

The limber resembles, in general construction, the French government service-limber; it consists of a frame-work of wood, placed upon wheels of equal size and construction as those of the gun-carriage.

The axle-tree is of steel; it has no axle-tree bed, but is attached directly to the "futchells."

The trail of the gun-carriage hooks up to a hook-pintail attached to the axle-tree. The limber has a swing splinter-bar to which the traces of the horses are attached, and the shaft is arranged for double-draught.

The limber carries an ammunition-chest made of wood, conveying four hundred rounds of ammunition, and it is fitted with four boxes, each containing one hundred rounds. The cartridges are held immovably in the boxes when the lids are closed to prevent their being injured in traveling over rough roads. The ammunition-chest is covered with painted sail-cloth, and is rendered water-tight; the corners are protected by angle-irons, and it is attached to the limber by two hooks and screws.

The weight of the limber, with ammunition-chest complete, is 661 pounds.

Summary of principal weights.

	Pounds.
Gun, with lateral-training apparatus	1,213
Carriage, with all accessories	926
Limber, with ammunition-chest	661
Four hundred and sixty rounds of ammunition	761
Four gunners	529
Total	4,090

This weight distributed over six horses gives 680 pounds per horse, a very low rate, the usual weight for the draught of a horse in light-artillery being about 771 pounds, so that this gun possesses that which in modern warfare is so necessary—the quality of easy transportability to a satisfactory extent.*

Since the publication of the above, Mr. Hotchkiss has made a slight improvement in his shell, which has been satisfactorily tried by the board.

The improved Hotchkiss shell is with its fuse a little less than three calibers in length, or about seven-sixteenths inch shorter than the one just described, from which it differs, with the above exception, in the following particulars only: The new shell has four circumferential grooves separated by ribs about one-twentieth inch wide, and longitudinal cuts between ribs. The tubing, about one caliber in length and one-sixteenth of an inch thick, instead of being corrugated on the exterior, as in the old shell, is perfectly smooth, and is contracted into place by a *slight* pressure only. The gas from the discharge presses the packing so firmly into the grooves and cuts that it cannot rotate independently of the projectile, and the rifling is impressed on the ribs only covered by the tubing.

Its dimensions and weights are as follows:

Length of body	3.66 inches.
Entire length with fuse	4.27 inches.
Length of brass coating	1.5 inches.

* The foregoing description of gun, shells, &c., was taken from the phamphlet of Mr. Alfred Koener, published in Paris, 1874. The French measures have been transferred into our own for convenience of reference.

Diameter of body	1.44 inches.
Diameter of brass coating	1.49 inches.
Weight of body of the projectile	1 pound 1.4 ounces.
Weight of fuse	3.3 ounces.
Weight of bursting-charge	0.88 ounce.
Total weight of projectile complete for firing	1 pound 5.58 ounces.

RESULTS OF FIRING AT SANDY HOOK, NEW YORK HARBOR.

On the 11th of September, 1876, the preliminary trial of the gun took place, Mr. Hotchkiss being present.

Forty rounds were fired with new mortar-powder, testing the working of the gun. On the 12th and 22d, same month, the gun was fired for *initial velocities*, the average of three rounds new mortar-powder giving 1,294 feet; of 12 rounds, musket, 1,572 feet, and of 18 rounds, old mortar, 1,458 feet. September 21 and 22, 72 rounds were fired at a target 1,000 yards distant, and 51 rounds at a 2,000-yard target, not including sighting-shots. (See targets marked A and B, plates 5 and 6, appended.) September 22, 4 rounds of shell and 26 of canister were fired at a 200-yard target. The working of the canister not being very effective, no further trials were made with it at even these short ranges, the shell, everything considered, being deemed more satisfactory than canister. On the 3d of October the gun was again fired 72 rounds, testing its workings. Up to this time 309 rounds in all had been fired.

A supply of 3,000 rounds of ammunition having been procured, the board resumed its experiments November 23, 1876, and concluded them February 15, 1877.

November 23, 1876, 115 rounds were fired at target 2,000 yards distant, and the time taken of firing 20 and 51 shots; and on the 24th of November, 15 rounds were fired at targets 2,640 yards distant, but owing to high winds the firing was suspended and targets not tabulated.

On the 2d of December 143 rounds were fired at 1,000-yard targets, not including 7 sighting-shots. (See targets marked C, plate 7, appended.) One hundred and seventy rounds were fired at 2,000-yard targets, not including 4 sighting-shots. (See targets marked D, plate 8, appended.)

On January 25, 1877, 102 rounds were fired at 10 targets, the first being 200 yards distant; and on same date 100 rounds were fired at 2 targets, the first the same distance from gun. (See targets marked E and F, plates 9 and 10, appended.)

On February 14, 1877, 44 rounds were fired at targets 200 yards distant, and on the 15th 100 rounds were fired at targets 1,000 yards distant, not including 12 sighting-shots. (See targets marked G and H, plates 11 and 12, appended.)

This makes a record of 1,136 rounds in all fired, and throughout the firing the gun worked well. There were four failures in the ammunition during the early part of the firing, owing to the weakness of the firing-pin spring, but after this spring was changed no failures occurred.

The fuses, with one exception, worked perfectly; on examining this fuse after firing, it was discovered that the fuse-firing pin on nose-screw was broken, which would readily account for the failure to explode.

The cartridge-cases, of wrapped metal, worked well, extracted easily, and no gas escaped. The loader and extractor worked easily and well, as did the mechanism generally. There was no wabbling, tumbling, or stripping of projectile, the brass coat or packing taking the grooves well in all cases. In fact, with the exception of the four miss-fires and one

failure to explode, already explained, everything worked very satisfactory during the entire firing.

The special carriage for this cannon seems strong, compact, and serviceable, and possesses some novel features. The recoil-brake, which takes the place also of the ordinary shoe-brake, is secured to the axle-arm, and works by means of a short lever. This brake, and also the shield, which, when not in use, folds and forms seats for the cannoniers, have been fully described heretofore. There is also at the end and under side of trail a pointed, wedge-shaped piece of iron, which, being forced into the wooden platform or ground, prevents the trail from moving during firing.

ACCURACY AND EFFECTS.

The targets were made of one-half inch and one-inch boards, and were constructed in sections, which enabled them to be rapidly erected and placed in their required position.

It will be seen (Record of Firing, appended) that they were grouped for the different ranges of 200, 1,000, and 2,000 yards, and that the sizes were such as to cover, generally, all cases of different army formations. All the useful effects of fire were thus recorded on them, and its full value made apparent.

Results at 200 *yards. Targets E, F, G, appended—Plates* 9, 10, *and* 11.

Three different series of targets were placed at 200 yards. At the first (10 targets, 52 feet by 6 feet, 50 feet apart) 102 shells were fired, giving 2,140 hits. At the second (2 targets, 52 feet by 11 feet, 75 feet apart) 100 shells were fired, giving 1,045 hits. At the third (2 targets, 26 feet by 6 feet, 75 feet apart) 44 shells were fired, giving 309 hits.

The destructive effects on the first series are apparent, giving about 1,600 hits per minute, and using only about 125 pounds of metal.

The other series also illustrate the destructive power of this weapon at short ranges, such as would be used in the service of our armament for the flank-defenses of our sea-coast fortifications.

Results at 1,000 *yards. Targets A and C, appended—Plates* 5 *and* 7.

Two targets (11 feet by 26 feet) were made at this distance, firing in the first case 72 rounds, and in the second 143. The total number of hits was 1,597 for 215 projectiles in all fired. As the time of firing is about 80 rounds per minute, an analysis shows that a continuous and dangerous fire (about 590 hits per minute) can be secured at this range. A third series, (target H, appended, Plate 12,) firing at 10 targets (52 feet by 6 feet, 50 feet apart, and representing a regiment in column) was made, using 100 shells; 1,626 hits were noted. This gives a continuous and dangerous fire of 1,300 hits per minute, and using only 125 pounds of metal—results not yet attained in any other machine-gun, nor with our present field-artillery. The range of 1,000 yards, however, is one too long for accurate effects, generally, from the lighter caliber of other machine systems, (fired even with great deliberation.)

Results at 2,000 *yards.—Targets B and D—Plates* 6 *and* 8.

The targets made at this distance were accomplished by firing 221 rounds; and the total number of hits was 1,019; a continuous and dangerous fire, at this range, of 370 hits per minute.

Any comparison at this distance ceases with other machine-guns; and we have to consider the system at this range, as a competitor of field-cannon.

No direct comparisons have been as yet made by the board between the Hotchkiss revolving cannon and the ordinary field-pieces, but it is thought well to allude in this connection to the more recent practice with the most approved field-artillery. The recent experiments in Austria are probably the best so far made, and will afford us a fair comparison. This comparison will be incomplete, but this incompleteness will favor the field-artillery rather than the Hotchkiss system.

The records alluded to show that 40 shells, "with double walls," weighing in the aggregate, say, 560 pounds, gave 1,497 hits on targets placed at 1,658 yards. The time required for accurate firing could not have been less than ten minutes. This amount of metal if delivered from the Hotchkiss revolving cannon would, if a ratio following from the results already quoted is accepted, give 2,000 hits, and at a distance of 2,000 yards, and in a time of seven minutes.

Comparison cannot be made at the maximum ranges (4,000 yards) reported by the Austrian artillery, as no records are yet made at this distance with the revolving cannon.

RESULTS IN FRANCE AND BRAZIL.

An inspection of the results of firing at Gavre (Appendix 1) will show that, at a range of nearly 2,000 yards, as favorable results as those given at Sandy Hook were attained; the rapidity of fire being the same, and the number of hits (354) in a record of 80 shots showing nearly the same percentage as our results at the above-mentioned range. The range and accuracy attained also show a capacity for effective fire up to about 5,500 yards.

The trials also at Gavre with the revolving cannon, (Appendix 2,) French marine model, also gave strong confirmatory evidences of its superiority in range and accuracy, besides its effectiveness in other respects.

The results in Brazil also highly favorable to the gun, and the official opinions of its merits decided. (See report annexed, Appendix 3.)

DISCUSSION OF THE SYSTEM.

The introduction of this gun has marked a new departure in that class of arms which next succeeds in power the personal weapons of the soldier; and it gives fair promise as a powerful auxiliary to our modern field systems, and to our present contemplated armaments for the defense of the short flank-lines of our permanent works.

It is evident that, in the latter service, a long-range gun capable of securing an intense, accurate, continuous, and deadly fire at the short ranges ordinarily employed for this service, and having most of the advantages of the howitzer-fire, formerly fully, and now partially, relied upon for protecting our ditches and flank-lines, under all ordinary circumstances of attack, must prove a highly desirable adjunct, if not a superior means of defense to the present systems employed; limited as they are in power, and consequently in range, and without superiority in rapidity and continuity of fire, or in deadly effects.

Its range is at least 5,500 yards, which renders it equally as powerful as a shell-gun in this respect, and one capable of guarding the approaches to works, either permanent or field, at shell-gun distances,

while at the same time being effective at ranges of 1,000 to 1,500 yards, the maximum distances ordinarily required to be covered by our flank-defense armaments.

Its power for delivering a continuous and uninterrupted effective fire at ranges indifferently from the shortest range required up to three miles, would seem to point to it or a similar system—employing the same general principles—as being a *necessity* for introduction in the future armament of our forts, and for service, when occasion demands, in our field-works.

In this connection, as germane to the question of flank-defense, the board would call attention to the importance of the introduction into our service of a shell-gun of more accuracy, length of range, and destructiveness and rapidity of fire than the present 8-inch howitzer. This, it is believed, can be attained by a breech-loading rifle-howitzer of a caliber of 6 inches, throwing canister for short ranges as well as case-shot, and using the latter with percussion or concussion fuses; and for all ranges a special case-shot weighing 65 pounds, and containing bullets, 14 to the pound; also canister of a weight of, say, 54 pounds, using 0.8-inch lead bullets, and a shell of 61 pounds.

The effects with these projectiles must be decidedly superior to those attainable with our present 8-inch-howitzer ammunition, and in order to perfect a flank-defense howitzer, it is recommended that experiments in the direction indicated also be undertaken in connection with others now pending, looking to a proper armament of our flank-defenses.

REGARDING FIELD-SERVICES.

It is evident that this system gives promise of proving a valuable and powerful auxiliary to the light artillery of our service.

Its equality in range, its greater capacity for delivering a deadly, incessant, and widespread fire at all field-ranges, and with decidedly superior rapidity; its stability when fired, abolishing all but the ordinary initial pointings, and its evident superiority in pursuing retreating columns, give it some decided advantages, apparently, over our ordinary field-guns.

For the effects of artillery-fire, however, where penetration is desirable, and where destructive effects of solid shot and shell, in rapidly demolishing large objects, &c., are required, we must, of course, yield the advantage to the larger calibered field-pieces.

Its uses, however, as a powerful auxiliary to the service under consideration cannot be doubted from the above considerations; and the board believes that its great efficiency as a field-piece, when tested, will probably be established.

RECOMMENDATIONS.

The results of the above recorded tests of the Hotchkiss revolving cannon at Sandy Hook, and the records of the results obtained abroad, lead the board to recommend, further, more extended and exhaustive trials to fully determine its merits, with a view to its final adoption as an auxiliary arm, not only for flank-defense, but for other branches of the service. To further this end, the board recommends the procurement of at least 4 guns (the number to be governed by the state of the appropriation) of the model and caliber tested; and with a supply of ammunition not exceeding 2,000 rounds per gun, the carriages needed to be made at the Watervliet arsenal, after well-matured drawings to

suit the nature of our service. Two of the guns procured to be placed in the field, to be reported upon after thorough trial, and two, with carriages adapted for flank-defense casemate-service, to be placed in some of our casemated works for trial and tests. It further recommends that experiments be continued with the present gun at Sandy Hook.

S. CRISPIN,
Bvt. Col. U. S. A., Lt. Col. of Ord., President of the Board.
T. J. TREADWELL,
Major of Ordnance.
T. G. BAYLOR,
Major of Ordnance.
FRANK H. PHIPPS,
Captain of Ordnance, Recorder.

Extract of the report of the trial of B. B. Hotchkiss revolver cannon, made by the French government at Gavre.

GENERAL OBSERVATIONS.

The mechanism of the cannon revolver is simple, and substantially made.

The traverse apparatus is simple, and works satisfactorily.

The iron gun-carriage has worked well during all the trials.

The fuse is simple, without any danger for manipulation, and requires no preparations on the battle-field.

Ballistical properties.—The elevation for the maximum range is about 35°; range, 4,600^{m}, (about 5,031 yards.) The accuracy of the revolver cannon in horizontal deviations is remarkable, and very much superior to that of the mitrailleuse.

Obturations.—The gas-check produced by the cartridge has been constantly good. The system of the cartridge-case is a good one.

Working of mechanism.—The working of the firing-pin has been constantly good. The loader worked always well during all trials. The principle of the extractor is a good one. The traverse motion and the elevating-screw worked always well.

Working of the brass coats of projectiles.—The projectiles examined after firing showed the print of the bands on the coat very distinctly, and of the same width as the bands. The results show this principle of the brass packing to be a good one.

Time of salvos.—Mean time for ten shots, 11.6 seconds.

RESULTS OF FIRING, (EXTRACT OF REPORT.)

Firing against a battalion in columns by division at entire distances. (Experiments of 27th February, 1873.)

The batallion is represented by 3 targets of 1.80 meters (about 6 feet) height, and 70 meters (about 230 feet) width. The first at 1,650 meters (about 1,804 yards) from the cannon. The second at 1,720 meters, (about 1,881 yards.) The third at 1,790 meters, (about 1,957 yards.)

Powder-charge, 85 grains; bursting-charge, 20 grains, powder du Ripault.

Angle of fire, 6° 36′.

Two salvos of 40 shots fired, the first without traversing, the second with traversing.

The number of projectiles or pieces which, per hundred, reached the targets are, for the revolver cannon, 70.

In comparing this result with those obtained by the Gatling mitrailleuse in the same condition, it was found for the—

Caliber .45, Gatling mitrailleuse No. 150, number of hits, 11.25.

Caliber .45, Gatling mitrailleuse No. 161, number of hits, 3.72.

The superiority of the revolver cannon is well marked.

Firing with shells against a battalion in column by division at entire distances. (*Tests of 25th July*, 1873.)

The battalion is represented by 6 targets of 1.80 meters (about 6 feet) height, and 35 meters (about 115 feet) width. The distance between is 35 meters, (about 115 feet.) The last target 1,795 meters (about 1,963 yards) from the revolver cannon.

Powder-charge, 85 grains; bursting-charge, 20 grains; powder of Ripault. The firing is regulated to drop the projectiles between the 3d and the 4th targets.

Angle of fire, 6° 30′.

Two salvos of 40 shots fired without traversing.

The number per hundred of hits is, for the revolver cannon:

1st salvo, 109; the second salvo of 40 shots fired in 30 seconds: 2d salvo, 245.

For the 1st caliber, Gatling mitrailleuse No. 81: 1st salvo, 24; 2d salvo, 48; 3d salvo, 57.3.

For the .65 caliber Gatling mitrailleuse No. 10: 1st salvo, 25; 2d salvo, 35; 3d salvo, 54; 4th salvo, 18.7.

The Hotchkiss revolving cannon, therefore, produces a much superior effect to that of the mitrailleuse Gatling.

Firing against a steel plate of 10 millimeters (about 0.3937 inch) thick; distance, 150 meters, (about 492 feet.) (*Experiments of July 25, 1873.*)

Three shots.

1. Goes through and explodes in coming out.

2. Goes through and explodes in coming out.

3. The shot, badly directed, hits at left a sheet-iron of 10 millimeters (about 0.3937 inch) thick, supported by a piece of oak of 20 centimeters (about 7.874 inches) square. The projectile exploded in the wood, which was split to the length of about one meter, (about 3.28 feet.) The hole measures behind about seven centimeters (about 2.76 inches) of width. The piece of iron detached from the sheet went through the wood, and dropped at 4 or 5 meters (about 15 feet) beyond.

SENSIBILITY OF FUSES.

The cannon was pointed seaward and fired.

1. Two shots at an angle of 2′. The shell exploded on touching the water.

2. One shot at + 15′. The shell exploded on touching the water.

3. One shot at 2°. The shell exploded on touching the water.

4. One shot at 3°. The shell exploded on touching the water.

5. One shot at 5°. The shell exploded on touching the water.

TRIAL OF SAFETY OF FUSES, (25TH JULY, 1873.)

Three shells were suspended by a string, the point downward. When the string was cut, the shell with the fuse fell on a sheet-iron plate the height of 3.32 meters, (about 11 feet.) The fuse did not explode and the mechanism did not move.

TRIAL OF FUSES, (EXPERIMENTS 21ST JANUARY, 1874.)

All the empty shells penetrated into the earth from 30 to 40 centimeters (about 13 inches) depth. The fuse had exploded in all that were found.

RANGE, (EXPERIMENTS OF JANUARY 20, 1874.)

Charge of powder, 150 grains "R. L. G." Some of the projectiles fired at 30° elevation, which were not found, struck the ground at a distance of 5,000 meters, (about 5,468 yards.)

The projectile fired at 35° elevation had a range exceeding 5,000 meters, (exceeding 5,468 yards.) Some of the assistants saw it fall, but could not find it because the ground was too rough.

ACCURACY, (EXPERIMENTS OF JANUARY, 1874.)

Powder-charge, 100 grains, powder of Ripault; angle of fire, 35°.

Shell.

Mean range, 4,014 meters, (about 4,390 yards.)
Maximum range, 4,023 meters, (about 4,400 yards).
Minimum range, 3,998 meters, (about 4,372 yards.)
Difference in range, 25 meters, (about 27 yards.)
Maximum deviation, 64.2 meters, (about 70.21 yards.)
Minimum deviation, 60.2 meters, (about 65.83 yards.)
Difference in deviation, 4 meters, (about 4.38 yards.)

The shells fired hit the ground at over 4,000 meters (about 4,375 yards) distance, within a space of 25 meters (about 27 yards) length and 4 meters (about 4.38 yards) wide.

Solid shot.

Mean range, 4,454 meters, (about 4,871 yards.)
Maximum range, 4,466 meters, (about 4,884 yards.)
Minimum range, 4,442 meters, (about 4,857 yards.)
Difference in range, 24 meters, (about 26 yards.)
Maximum deviation, 62 meters, (about 67.8 yards.)
Minimum deviation, 60.6 meters, (about 66 yards.)
Difference in deviation, 1.4 meters, (about 1.5 yards.)

The projectiles hit the ground at a distance near 4,500 meters, (about 4,921 yards,) within a space of 24 meters (about 26 yards) length and 1.4 meters (about 1.5 yards) wide.

Extract from the report upon the Hotchkiss revolving cannon, model of the French marine.—(Experiments of Gavre, February and March, 1877.)

The modifications applied to the cannon-revolver for the service of the marine have had for their principal object the giving to the piece a sufficient lightness and mobility to enable the same man to execute a continuous fire, and to rectify the pointing at each shot.

The necessary mobility has been obtained by mounting the piece upon a fork pivoted in a socket, and this is rendered sufficient, because the cannonier who points supports the left shoulder against a trail-piece, and holds with the left hand a handle placed under the breech, and, while turning with the right hand the crank, is able at the same time to follow the object with the line of sight.

It is proposed to have some small pieces, which, placed upon different parts of a vessel, shall be able to protect disembarcation from small crafts and torpedo-boats.

To fulfill this object we should have great accuracy up to 2,187 and 2,734 yards, sufficient rapidity of fire and penetration, at these distances, of plates from .20 inch to .24 inch; also the piercing of sheathing of launches.

PENETRATION OF THE-SHELLS.

The shell of 14.85 ounces, of ordinary cast iron, gave dangerous fragments in bursting on its passage through a plate of sheet steel of .24 inch, with a velocity at impact reduced to 482 feet (corresponding to a distance of 2,187 yards) under an angle of 22°, or with a velocity at impact of 623 feet (corresponding to a distance of 1,640 yards) under an angle of 30°.

It gave more than six dangerous fragments per shot in passing with a velocity at impact of 1,302 feet in normal fire against a steel plate about .6 inch thick. It gave again some dangerous fragments after having traversed 11.8 inches of wood under an angle of 0°, with a velocity of about 722 feet; after having traversed 11.8 inches of wood, under an angle of 30°, with a velocity at impact of 1,302 feet, and after having traversed a wall of 3.9 inches, under an angle of 30°, with a velocity at impact of about 722 feet.

FIRING AT VESSELS IN MOTION.

This firing was easily done by two men, although the gunner was not accustomed to fire upon the sea at a movable target, nor to the sight that was used. This firing showed remarkable accuracy, since fifty good shots were observed out of 108 fires. The balloon which served as a target (31½ inches diameter) was reduced to pieces; and the stem, the upper part of which was attached to the balloon and had 2.36 inches of cross-section, was cut away and riddled with shot, and the remaining stump, of which the lower part was about .45 inch cross-section, bore the trace of many shells, attesting the efficacy of the fire against a target of very small dimensions.

RESISTANCE OF THE CARTRIDGE-CASES EMPLOYED IN FIRING.

It is found that the same case can be used (by re-priming) four or five times.

GENERAL SUMMARY AND CONCLUSIONS.

The Hotchkiss revolving cannon (marine model) fulfills the many con-

ditions for the employment to which it is destined—that is to say, the defense of vessels against small crafts and torpedo-boats.

The commission thought, in addition, that it was fitting to examine if this arm would serve to a good use in the protection of the embarcation of troops.

The extent of its ranges and its longitudinal accuracy are remarkable, and its lateral accuracy is satisfactory.

The results of firing-practice aboard ship, executed with shells of 14.85 ounces, showed that the ballistic qualities of the revolving cannon would be utilized in the most difficult conditions of a movable target.

For a distance estimated at the beginning of a volley, and variable, a mean velocity of fire of about one shot in five seconds in regular working and practice is reasonably sufficient to secure the effects of each fire.

The shell of 14.85 ounces, of ordinary cast iron, charged and fitted with a percussion fuse, normally pierced plates of steel of .24 inch and up to 2,187 yards distance; and under an angle of 30° up to about 1,640 yards. This same shell normally pierced 11.8 inches of oak wood at 547 yards, and 3.9 inches of oak wood under the angle of 30° at the same distance. Its explosion gave, even after the perforation of those obstacles, some dangerous fragments.

The shell of about 1 pound, of the same metal, will have a greater effect, especially at great distances.

Two men are sufficient for serving the cannon.

[Translation.]

Report of the minister of war to the general legislative assembly of Brazil, on the Hotchkiss revolving cannon, made at Rio de Janeiro, 1875.

[Extract.]

The artillery committee highly recommend the Hotchkiss revolving cannon, and state that the smallness of its caliber is compensated for by the rapidity of fire, as about 80 rounds per minute can be discharged from it, while one round can only with difficulty be discharged from other systems, (Whitworth, Krupp, &c.)

Each shell of the revolving cannon gives 10 to 11 useful fragments; the gun produces, therefore, about 800 fragments per minute. The Whitworth and Krupp guns give only 7 to 9 useful fragments during the same time, having the same range and precision as the revolving cannon.

The maximum range of the gun is 4,500 meters (about 4,921 yards) with French powder, or about 5,000 meters (about 5,468 yards) with our own powder, which at present appears to be of the best quality.

The sample gun purchased by the imperial government, at the request of the artillery committee, (though not quite complete, as it was not provided with the shield to protect the gunners against sharp-shooters,) proved at the experiments on the firing-grounds to be an excellent weapon, as it possesses the following qualities:

Great range.

Perfect accuracy of fire.

Absence of recoil, due to the special brakes.

Quick loading, simple and almost automatic.

Great rapidity of fire.

Metallic cartridge, which can be reloaded on the average 8 times, and allowing the primers to be changed with great facility.

Simple and strong mechanism, composed of only 7 parts, which load, fire, extract and drop the empty cartridge-shell to the ground.

Complete obturation and forced projectile.

Operation by only four men, who can easily be protected by entrenchment of the gun.

The artillery committee express the opinion that the practical results will perhaps recommend the adoption of this system as the only artillery for our army.

Signed—the secretary of state and minister of war.

Harbor.

Date.	Weather. Direction of wind.	Weather. Strength of wind in miles per hour.	Remarks.
1876–'77.			
September 11	.....	.....	Fired to test working of gun.
September 12	.....	.....	Fired to obtain velocities.
September 12	.....	.....	Do.
September 12	.....	.....	Do.
September 21	L. to R	8	Target A.
September 22	..do ...	21	Target B.
September 22	.....	.....	o draught of target made.
September 22	.....	.....	Do.
October 3	.....	.....	Fired to test working of gun.
November 23	.....	.....	No draught of target made; 1 miss-fire.
November 24	.....	.....	Do.
December 2	.....	22	Target C.
December 2	.....	22	Target D; 3 miss-fires.
January 25	.....	.....	Target E.
January 25	.....	.....	Target F.
February 14	.....	.....	Target G.
February 15	.....	.....	Target H.

NOTE.—n rounds (averaging) fired in 7½ seconds.

CARRIAGE No. 2. (Plate II.)

This carriage differs from No. 1 only in the means employed for elevating and depressing the gun, a lever and fulcrum similar to those on the original carriage for 10-inch smooth-bore Rodman being used. Table No. 1, accompanying, will, therefore, show the results of firing with both Nos. 1 and 2, so far as the recoil-check and the running in and out of battery of upper carriage are concerned.

CARRIAGE No. 3. (Plate III.)

This carriage, designed by the constructor of ordnance, possesses the same general features as the one adopted for the 12-inch rifle. The same elevating and depressing apparatus is used as on carriage No. 1.

To check recoil a hydraulic buffer is used, which may be described as follows:

The buffer, securely placed in the front of the chassis, consists of a cast-iron cylinder 78 inches long, the exterior and interior diameters being, respectively, 11 inches and 8 inches. The cylinder is closed at each end by a cast-iron cap firmly attached to the cylinder by a series of screws. For the purpose of admitting water or any non-freezing fluid that may be used, a hole three-fourths of an inch in diameter and 16.25 inches from the rear is bored on the upper surface of the cylinder. A similar hole in the bottom of the front cylinder-cap permits the fluid to be withdrawn. Each hole is closed by a screw-plug. The piston-rod, 2.25 inches in diameter, is made of wrought iron, and, after passing through the rear cap, is attached to a cross-head of wrought iron 11.25 inches high and 26 inches long, which, in its turn, is secured to the rear of the top carriage. To allow the piston-rod a vertical play, the hole through which the end passes is made oblong. Through the ring which forms the end of the rod a steel cylindrical pin is passed, at each end of which is a steel friction-roller. The piston-head, of wrought iron 2.5 inches thick, is pierced with two holes near its circumference on opposite sides of the rod. These holes, seven-eighths of an inch interior diameter, flare out both ways 2.5 inches and give the fluid, acted upon by the piston-head when the gun is fired, sufficient escape, and, while checking recoil, allows the top carriage to move back without strain.

To the top of each rail of the chassis, and 95 inches from the front end, is bolted an incline or wedge, having a rise of 2.5 inches in 64 inches. Its breadth is 3.25 inches. Near the end of, and in this incline, a cut is made 6 inches wide, to receive an angle-iron 6 inches by 6 inches. To this angle-iron 3 spring hurters of rubber, 5 inches long by 5 inches diameter, are secured by screw-bolts. The upper carriage is provided with two sets of wheels or rollers, which are secured to the front and rear; the first, by pieces of wrought iron bolted on each side of carriage, and the latter by bronze Vs screwed and keyed to the rear end of carriage. The rear wheels have eccentrics. In recoiling, after firing, the carriage starts and moves on sliding friction, but when it has accomplished part of the rise the sliding becomes rolling friction, and the ascent of the inclined plane absorbing a considerable portion of the recoil. To prevent the carriage running in battery, as it would naturally do after striking the hurters, two sets of couplings are used; one set permanently fixed to the bottom transom of the upper carriage, and the other set to the side of the chassis-rails. The latter are hinged, and when it is desirable to release the gun, as after loading, are moved by means of suitable levers conveniently placed on the outside of the

chassis-rails. Upon releasing the catches or couplings the gun runs promptly and easily into battery. To the front transom of the chassis are secured by similar irons the same number and kind of hurters as those at the rear. For working of carriage, see table No. 2, accompanying.

CARRIAGE No. 4. (Plate IV.)

Has the same hydraulic buffer as No. 3, but has no inclined plane, side-catches, or elevating-racks, the gun being elevated and depressed by means of the lever and fulcrum used on the 10-inch S. B. Rodman.

In place of the front and rear eccentric rollers used on No. 3, it has the same axles and wheels as Nos. 1 and 2. It is provided with the same rubber hurters and counter-hurters as No. 3.

S. CRISPIN,
Bvt. Col. U. S. A., Lieut. Col. of Ordnance,
President of the Board.
T. J. TREADWELL,
Major of Ordnance.
T. G. BAYLOR,
Major of Ordnance.
FRANK H. PHIPPS,
Capt. of Ordnance, Recorder.

TABLE No. 1.—*Record of firing at Sandy Hook, New York Harbor, testing altered carriages Nos. 1 and 2, for converted guns.*

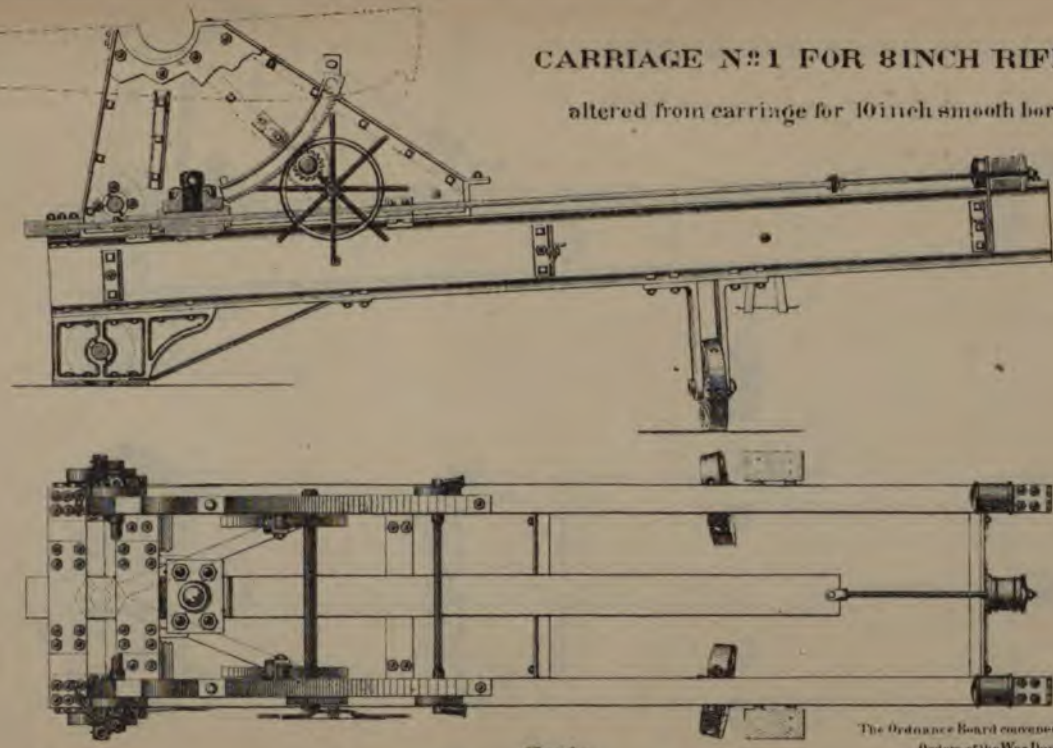
Date.	Number of rounds.	Powder.			Projectile.		Elevation, degrees.	Velocity, feet.	Maximum pressure per square inch at surface of bore.	Recoil of upper carriage, feet.	Counter recoil, inches.	Remarks.
		Kind.	Density.	Charge, pounds.	Kind.	Weight.						
1877.												
April 10	1	Du Pont's hexagonal F. U. E. V.	1.75	25	Butler	165	−1½	.....	.....	2.58	.....	Clamp-screws released, carriage did not run into battery until the head of friction-plate had been tapped with a sledge-hammer, when it ran into battery itself and easily. This was due to a defective friction-plate, which was afterward changed.
April 10	1	....do	1.75	30	....do	165	−1½	.....	.....	2.75	.....	
April 11	2	....do	1.75	35	....do	170	−1½	.....	.....	3.08	1	
April 11	2	....do	1.75	35	....do	180	−1½	.....	.....	3.18	1½	
April 23	1	....do	1.75	25	....do	170	−1½	.....	.....	3.75	.....	Carriage worked well with new friction-plate. The clamp-screw being released and rear wheels thrown "in gear," the carriage ran easily and freely into battery. The clamp-screw not being sufficiently tight at last round the carriage recoiled its full extent, striking the rear hurter-plate, bending axle.
April 18 and 23	2	....do	1.75	30	....do	170	−1½	.....	.....	3.91	.....	
April 20	1	....do	1.75	35	....do	184	−1½	.....	.....	4.33	.....	
April 20	1	....do	1.75	35	....do	165	−1½	.....	.....	3.58	.....	
May 19	1	....do	1.75	35	....do	180	−1	1,324	20,000	6.17	.....	

TABLE No. 2.—*Record of firing at Sandy Hook, New York Harbor, testing altered carriage No. 3, for converted guns.*

Date.	Number of rounds.	Powder. Kind.	Density.	Charge, pounds.	Projectile. Kind.	Weight.	Elevation, degrees.	Velocity, feet.	Maximum pressure per square inch at surface of bore.	Recoil of upper carriage, feet.	Counter recoil, inches.	Remarks.
1877.												
March 2	1	Du Pont's hexagonal F. U. E. V.	1.75	20	Butler	180	−1½					At the 2d, 3d, 4th, 5th, and 6th rounds gun did not recoil to rear barters, or else, recoiling, did not catch properly on claws. This was corrected, and in every subsequent case the carriage worked very satisfactorily, recoiling, catching in claws, and when released running smoothly and easily into battery.
March 2	1	do	1.75	25	do	180	−1½					
March 8	1	do	1.75	30	do	180	−1½					
March 8	13	do	1.75	35	do	180	−1½					
March 9		do	1.75	35	do	180	−1½					
March 14		do	1.75	35	do	180	−1½					
March 16		do	1.75	35	do	180	−1½					
March 31		do	1.75	35	do	180	−1½					
April 12		do	1.75	35	do	180	−1½					
March 31	2	do	1.75	35	do	170	−1½					
March 31	1	do	1.75	35	do	172	−1½					
April 20	1	do	1.75	35	do	183	−1½			4.25		
April 20	1	do	1.75	35	do	170	−1½			4.25		
May 8	1	do	1.75	35	do	162	10			Full		
May 12	1	do	1.75	35	do	180	10			Full		
June 12	1	do	1.75	35	do	170	−1	1,364	21,000	4.25		
June 2	2	do	1.75	35	Reilly	180	−1	1,314	25,500	4.25		
June 2	1	do	1.75	35	do	182	−1	1,313	15,000	4.25		
May 19	2	Pigou, Wilks & Laurence, English Pebble. 13¼	1.736	25	Butler	180	−1	1,236	18,750	4.25		
May 19	3	13¼	1.736	35	do	180	−1	1,377	38,333	4.25		
May 19	1	13	1.749	25	do	180	−1	1,223	26,500	4.25		
May 19	1	13	1.749	35	do	180	−1	1,377	55,000	4.25		
May 19	1	13	1.749	35	do	175	−1	1,411	58,500	4.25		
May 19	1	13½	1.756	35	do	180	−1	1,404	45,000	4.25		
June 23	1	13½	1.756	25	do	175	−1	1,184	27,500	4.25		
June 23	2	13½	1.756	35	do	172	−1	1,404	51,750	4.25		

CARRIAGE N°1 FOR 8INCH RIFLE.

altered from carriage for 10inch smooth bore.



Scale.

Inches.

The Ordnance Board convened under
Orders of the War Dept. S.O.N°129 of June 27th 1876.
Frank A. Gibbs
Capt of Ordnance
Recorder.

Accompanying Report of the Ordnance Board—Appendix 3, 1877.

Plate I.

Some few rounds of a cubical powder from Laflin & Rand were fired in the 9-inch rifle and 15-inch smooth-bore, (see Tables Nos. 9 and 10,) which gave in the first case excellent results; that tried in the 15-inch smooth-bore gave fair but not as good results as the hexagonal E. V.

None of the experimental powders have, so far, been sufficiently tested to enable the board to decide definitely as to their merits, but further experiments will be made with those which promise best.

S. CRISPIN,
Bvt. Col., U. S. A., Lt. Col. of Ordnance,
President of the Board.
T. J. TREADWELL,
Major of Ordnance.
T. G. BAYLOR,
Major of Ordnance.
FRANK. H. PHIPPS,
Captain of Ordnance, Recorder.

[Extract.]

TABLE No. 1.—EXPERIMENTS AND REPORTS WITH CANNON AND PROJECTILES.—CLASSES 1, 4, AND 5.

Target-record of firing with 8-inch converted rifle No. 1, at Sandy Hook, New York Harbor.

No. of fire.	Time.	Powder. Kind.	Powder. Weight.	Projectile. Kind.	Projectile. Weight.	Elevation.	Pressure per square inch of bore.	Initial velocity.	Recoil.	Counter-recoil.	Wind, strength and direction.	Number of powder lot.	Density of powder.	Special remarks about each fire, (such as effect on piece, sound of projectile in flight, scattering of fragments, &c.)
	1875.		*Lbs*		*Lbs. Oz.*	° ′	*Lbs.*	*Feet.*	*Feet.*	*In.*				
701	Oct. 22	Du Pont's hexagonal	35	Experimental, (S)	182	−1	27,000	1,329	2.42	....	.....	6	.....	Fired into sand-butt.
702	Oct. 22	....do	35	....do	182	−1	27,000	1,350	2.96	....	.....	6	.....	Do.
703	Oct. 22	....do	35	....do	182	+8	26,500	.....	2.96	....	.....	6	.....	Fired over water; clear, smooth sound; time of flight, 11 seconds.
704	Oct. 22	....do	35	....do	181	+8	27,500	.....	2.89	....	.....	6	.....	Fired over water; sabot stripped; time of flight, 10½ seconds.
705	Oct. 22	....do	35	....do	181	−1	26,500	1,344	2.46	....	.....	6	.....	Fired into sand-butt; sabot stripped between gun and butt.
706	Oct. 23	E. V. G. I.....	35	Butler	170	−1	31,500	1,472	3.71	....	.....	....	.....	Do.
707	Oct. 23	....do	35	....do	170	−1	34,500	1,477	3.12	....	.....	....	.....	Do.
708	Oct. 23	....do	35	....do	170	−1	33,500	1,478	3.35	....	.....	....	.....	Do.
709	Oct. 23	....do	35	....do	170	−1	34,500	1,475	3.21	....	.....	....	.....	Do.
710	Nov. 3	F. U. E. V.....	35	Arrick	180	+3 5			2.67	....	L. to R..	9	.....	Fired at target; clear, smooth sound; direct hit.
711	Nov. 3	....do	35	Butler	180	3 5			3.17	....	Light ...	9	.....	Do.
712	Nov. 3	....do	35	Dana.....	180	3 5			2.83	....	.....	9	.....	Do.
713	Nov. 3	....do	35	Arrick	180	3			3.69	....	.....	9	.....	Fired at target; clear, smooth sound; went over target.
714	Nov. 3	....do	35	Butler	180	3			3.27	....	Brisk ...	9	.....	Fired at target; clear, smooth sound; direct hit.
715	Nov. 3	....do	35	Dana.....	180	3 5			3.29	....	.....	9	.....	Do.
716	Nov. 3	....do	35	Arrick	180	3			3.04	....	.....	9	.....	Fired at target; clear, smooth sound; direct hit; sabot stripped in passing through target.
717	Nov. 3	....do	35	Butler	180	3			3.04	....	.....	9	.....	Fired at target; clear, smooth sound; direct hit.
718	Nov. 3	....do	35	Dana.....	180	3 5			3.08	....	.....	9	.....	Fired at target; sabot stripped, struck ground 150 yards in front of gun.
719	Nov. 3	....do	35	Arrick	180	3			3	....	.....	9	.....	Fired at target; sabot stripped in passing through target.
720	Nov. 3	....do	35	Butler	180	3			3.21	...	.....	9	.....	Fired at target.
721	Nov. 3	....do	35	Dana.....	180	3 5			3.08	...	.....	9	.....	Fired at target; clear, smooth sound.
722	Nov. 3	....do	35	Arrick	180	3			2.71	...	.....	9	.....	Do.
723	Nov. 3	....do	35	Butler	180 8	3			3.09	....	.....	9	.....	Do.

724	Nov. 3	....do	35	Dana	180	3 5			3.08	....		9	.....	Do.
725	Nov. 3	....do	35	Arrick	180	3			2.88	....		9	.....	Do.
726	Nov. 3	....do	35	Butler	180 8	3			3.08	....		9	.....	Fired at target; clear, smooth sound; struck ground 4 paces in front of center of target; elevating apparatus gave way, causing muzzle to fall and shot to strike short.
727	Nov. 3	....do	35	Dana	180	3 5	Not taken.	Not taken.	3.08	....		9	.....	Fired at target; clear, smooth sound; went under target sabot stripped.
728	Nov. 4	....do	35	Arrick	180	3			3.67	....		9	.....	Fired at target; clear, smooth sound.
729	Nov. 4	....do	35	Butler	180	3			3.67	....		9	.....	Do.
730	Nov. 4	....do	35	Dana	180	3 5			3.71	....	L. to R.	9	.....	Fired at target; clear, smooth sound; sabot stripped about 200 yards from gun.
731	Nov. 4	....do	35	Arrick	180	3			3.71	....	12 miles per hour.	9	.....	Fired at target; clear, smooth sound.
732	Nov. 4	....do	35	Butler	180	3			3.83	....		9	.....	Do.
733	Nov. 4	....do	35	Dana	180	3 5			3.67	....		9	.....	Do.
734	Nov. 5	....do	35	Arrick	180	3			4.04	....		9	.....	Do.
735	Nov. 5	....do	35	Butler	181	3			3.81	....	(*)	9	.....	Do.
736	Nov. 5	....do	35	Dana	181	3 5			3.77	....		9	.....	Do.
737	Nov. 5	....do	35	Arrick	180	3			3.58	....		9	.....	Do.
738	Nov. 5	....do	35	Butler	180	3			3.58	....		9	.....	Fired at target; clear, smooth sound; ricochet hit; struck ground 20 paces in front of target.
739	Nov. 5	....do	35	Dana	180	3 5			3.50	....		9	.....	Fired at target; clear, smooth sound.
740	Nov. 5	....do	35	Arrick	180	3			3.52	....		9	.....	Do.
741	Nov. 5	....do	35	Butler	180	3			2.85	....		9	.....	Do.
742	Nov. 5	....do	35	Dana	180	3 5			3.33	....	(†)	9	.....	Fired at target; clear, smooth sound; went under target about center.
743	Nov. 5	....do	35	Arrick	180	3			3.12	....		9	.....	Fired at target; clear, smooth sound.
744	Nov. 5	....do	35	Butler	180	3			3.08	....		9	.....	Do.
745	Nov. 5	....do	35	Dana	180	3 5			2.94	....		9	.....	Do.
746	Nov. 5	....do	35	Arrick	180	3			2.81	....		9	.....	Do.
747	Nov. 5	....do	35	Butler	180	3			2.56	....		9	.....	Do.
748	Nov. 5	....do	35	Dana	180	3 5			2.69	....		9	.....	Do.
749	Nov. 5	....do	35	Butler	181	—1			2.58	....		9	.....	Fired into sand-butt.
750	Nov. 5	....do	35	....do	181	—1			2.98	....		9	.....	Do.
751	Dec. 21	....do	35	Experimental, (S)	180	—1	24,000	1,281	3.42	....		12	.....	Fired into sand-butt; projectile took grooves well.
752	Dec. 21	....do	35	....do	181	—1	27,500	1,296	4.27	....		12	.....	Do.
753	Dec. 21	....do	35	....do	181	5	25,000	.....	4.15	....		12	.....	Fired over water; clear, smooth sound; projectile took grooves well.
754	Dec. 21	....do	35	....do	181	5	23,500	.....	3.98	....		12	.....	Fired over water; shot tumbled.
755	Dec. 21	....do	35	....do	181	5	25,000	.....	4.04	....		12	.....	Fired over water clear, smooth sound; projectile took grooves well.
756	Dec. 21 1876.	....do	35	....do	181	5	25,500	.....	3.63	....		12	.....	Fired over water; shot tumbled.
757	Jan. 27	....do	35	....do	180	5	24,000	.....	4.58	....		17	.....	Fired over water; clear, smooth sound; projectile took grooves well.
758	Jan. 27	....do	35	....do	180	5	25,000	.....	4.50	....		17	.....	Fired over water; shot tumbled.
759	Jan. 27	....do	35	....do	180	5	28,500	.....	4.67	....		17	.....	Fired over water; irregular sound.
760	Mar. 25	....do	35	....do	180	—1	36,500	1,257	7.25	....		15	.....	Fired into sand-butt.
761	Mar. 25	....do	35	....do	183	—1	23,500	1,275	5.00	....		15	.....	Fired into sand-butt. After the 761st round the gun was sent to Centennial Exhibition.

Target-records of firing with 8-inch converted rifle No. 1—Continued.

No. of fire.	Time.	Powder. Kind.	Powder. Weight.	Projectile. Kind.	Projectile. Weight.	Elevation.	Pressure per square inch of bore.	Initial velocity.	Recoil.	Counter-recoil.	Wind, strength and direction.	Number of powder lot.	Density of powder.	Special remarks about each fire, (such as effect on piece, sound of projectile in flight, scattering of fragments, &c.)
	1875.		*Lbs.*		*Lbs.Oz*	° ′	*Lbs.*	*Feet.*	*Feet.*	*In.*				
762	Apr. 10	....do	25	Butler	165	—1 1/2	.....	.....	2.58	....	.....	....	1.750	Fired into sand-butt to try altered carriages.
763	Apr. 10	....do	30	...do	165	—1 1/2	.....	.....	2.75	....	.....	....	1.750	Do.
764	Apr. 11	....do	35	...do	170	—1 1/2	.....	.....	2.92	1	.....	....	1.750	Do.
765	Apr. 11	....do	35	...do	170	—1 1/2	.....	.....	3.25	1	.....	....	1.750	Do.
766	Apr. 11	....do	35	...do	180	—1 1/2	.....	.....	3.25	1	.....	....	1.750	Do.
767	Apr. 11	....do	35	...do	180	—1 1/2	.....	.....	3.12	1 1/4	.....	....	1.750	Do.
768	Apr. 12	....do	35	...do	170	—1 1/2	.....	.....	6.33	1 1/4	.....	....	1.750	Do.
769	Apr. 12	....do	35	...do	170	—1 1/2	.....	.....	4.58	....	.....	....	1.750	Fired into sand-butt to try altered carriages; projectiles took grooves well.
770	Apr. 12	....do	35	...do	170	—1 1/2	.....	.....	3.58	....	.....	....	1.750	Do.
771	Apr. 18	....do	30	...do	170	—1 1/2	.....	.....	3.75	....	.....	....	1.750	Do.
772	Apr. 20	....do	35	...do	184	—1 1/2	.....	.....	4.33	....	.....	....	1.750	Do.
773	Apr. 20	....do	35	...do	165	—1 1/2	.....	.....	3.58	....	.....	....	1.750	Do.
774	Apr. 23	....do	25	...do	170	—1 1/2	.....	.....	3.75	....	.....	....	1.750	Do.
775	Apr. 23	....do	30	...do	170	—1 1/2	.....	.....	4.08	....	.....	....	1.750	Do.
776	May 19	....do	35	...do	180	—1	20,000	1,324	6.17	....	.....	....	1.750	Do.

* Light breeze from rear to front, and slightly from left to right.

† Wind shifted from right to left.

October 22.—At beginning of firing, barometer 29.885; thermometer, 78; humidity, 51 per cent.
At 753d round, thermometer, 52; barometer, 30.232.
At 759th round, thermometer, 37; barometer, 29.920.

TABLE No. 2.—*Record of firing for endurance with an 8-inch experimental rifle (No. 1) from April 20, 1875, to March 25, 1876, at Sandy Hook, New York Harbor.*

Date.	Number of shots.	Charge.				Projectile.				Mean observed velocities of projectile at 110 feet from the muzzle of the gun, as recorded by the Le Boulenge chronograph.	Velocities at muzzle.	Energy of projectile.		Gas-pressure per □″ of surface of bore, as taken with Rodman's internal-pressure gauge.	Range.		Recoil of upper carriage.
		Kind of powder.	Cartridge.			Kind.	Weight.	Length.	Diameter.			Total at the muzzle.	Per inch of the shot's circumference.		At 5° elevation.	At 10° elevation.	
			Weight.	Diameter.	Height.							$\frac{W V^2}{2g}$	$\frac{W V^2}{2g^2 \pi R}$				
			Lbs	*In.*	*In.*		*Lbs.*	*In.*	*In.*	*Feet.*	*Feet.*	*Foot-lbs.*	*Foot-lbs.*	*Lbs.*	*Yards.*	*Yards.*	*Feet.*
April 24, 1875	6	Du Pont's hexagonal, F. U. E.	35	7.25	22	Arrick	169	18	7.95	1,428	1,437	5,330,738	213,441	31,500	.....	.....	3.19
April 24, August 6, 10, 12, 13, 14. November 3, 4, 5, 1875	55		35	7.25	22	....do	180	19	7.95	1,336	1,344	5,053,473	202,331	29,440	2,635.8	4,472.8	3.07
April 24, 1875	5		35	7.25	22	Dana	165	18	7.95	1,405	1,414	5,197,453	205,298	33,700	.....	.....	3.79
April 24, August 7, 11, 12, 13, 14. November 3, 4, 5	55		35	7.25	22	...do	180	19	7.95	1,326	1,333	4,939,385	197,687	30,880	2,604.8	4,428.0	3.41
May 26, September 30	21		35	7.25	22	Butler	169	18	7.95	1,373	1,382	5,016,742	200,860	26,666	.....	.....	2.89
August 9, 11, 12, 13, 14 April 28, 30, November 3, 4, 5.	73		35	7.25	22	....do	181	19	7.95	1,341	1,350	5,127,021	205,280	28,640	2,608.0	4,390.0	3.13
April 20, 1875	1		35	7.25	22	Experimental G.	173	18	7.95	1,359	1,367	5,009,064	200,557	29,000	.....	.....	.....
April 20, 1875	2		35	7.25	22	Experimental S.	167	18	7.95	1,407	1,416	5,048,870	202,151	31,000	.....	.....	.....
October 22, December 21, 1875. January 2, March 25, 1876.	16		35	7.25	22	...do	184	19	7.95	1,302	1,309	4,884,714	195,531	26,406	.....	.....	3.82
October 22, 1875	4	Du Pont's hexagonal, G. I. E. V.	35	7.25	22	Butler	170	18	7.95	1,476	1,486	5,834,725	233,616	33,500	.....	.....	3.35
April 26, 1875	4	Oriental hexagonal.	35	7.25	22	...do	186	19	7.95	1,299	1,306	4,919,566	196,978	33,666	.....	.....	3.64
May 26, 1875	6		35	7.25	22	....do	169	18	7.95	1,358	1,358	4,843,486	193,928	30,250	.....	.....	3.51
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Table compiled by Mr. Henry A. Sinclair, under direction of Capt. George W. McKee.

REMARKS.—Distance of first wire target from muzzle of gun, 60 feet; distance between first and second targets, 100 feet. This gun had been previously fired 513 and since times; in all, to June 30, 1877, 776 times.

TABLE No. 3.—*Table of enlargements of 8-inch converted rifle No. 1.*

Inches from bottom of bore.	Original play of tube.	Original diameter of bore.	Enlargement after five charges of 20 to 35 pounds.	A.	Enlargement from column A, (after "setting up" of tube.)							Total enlargement after 776 rounds, including "set up" of tube.
				Enlargement after 12 rounds; seven battering-charges.	After a total of 100 rounds.	After a total of 203 rounds.	After a total of 310 rounds.	After a total of 411 rounds.	After a total of 513 rounds.	After a total of 610 rounds.	After a total of 776 rounds.	
11	0.0105	7.985	No enlargement of bore; tube not "set out."	0.022	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.027
13	0.0105	7.985		0.020	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.025
16	0.0105	7.985		0.019	0.004	0.004	0.004	0.004	0.005	0.005	0.005	0.024
19	0.0105	7.985		0.019	0.006	0.006	0.006	0.007	0.008	0.008	0.008	0.027
22	0.0105	7.985		0.022	0.006	0.006	0.007	0.011	0.018	0.018	0.018	0.040
25	0.0105	7.985		0.020	0.007	0.008	0.009	0.012	0.016	0.016	0.028	0.048
28	0.0105	7.985		0.017	0.008	0.009	0.010	0.013	0.015	0.0205	0.024	0.041
31	0.0105	7.985		0.013	0.009	0.010	0.011	0.013	0.015	0.015	0.023	0.036
34	0.0100	7.985		0.009	0.006	0.007	0.008	0.010	0.011	0.011	0.017	0.026
37	0.0100	7.985		0.007	0.004	0.004	0.005	0.007	0.008	0.008	0.008	0.015
40	9.0100	7.985		0.003	0.003	0.003	0.005	0.006	0.007	0.007	0.007	0.010
45	0.0100	7.985		0.002	0.002	0.002	0.003	0.004	0.005	0.005	0.005	0.007
50	0.0095	7.985		0.002	0.002	0.002	0.002	0.003	0.004	0.004	0.004	0.006
55	0.0095	7.985		0.001	0.001	0.001	0.001	0.002	0.003	0.003	0.004	0.005
60	0.0095	7.985		0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.003	0.004
65	0.0095	7.985		0.001	0.000	0.000	0.000	0.001	0.002	0.002	0.003	0.004
70	0.0095	7.985		0.000	0.000	0.000	0.000	0.000	0.002	0.0025	0.004	0.004
80	0.0095	7.985		0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.002	0.002
90	0.0095	7.985		0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.002
100	0.0095	7.985		0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.002
118	0.0095	7.985		0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.002

W. S. STARRING,
Lieutenant of Ordnance.

The Ordnance Board convened under orders of the War Department, Special Order No. 129, of June 27, 1876.

FRANK H. PHIPPS,
Captain of Ordnance, Recorder.

TABLE No. 7.—*Table of enlargements of 9-inch converted rifle No. 4.*

Inches from bottom of bore.	Original diameter of bore.	Enlargement after a total of 5 rounds.	Enlargement after a total of 31 rounds.	Enlargement after a total of 116 rounds.
15	9.039	0.001	0.003	0.004
17	9.039	0.001	0.002	0.004
19	9.038	0.000	0.002	0.004
21	9.038	0.000	0.001	0.002
23	9.037	0.000	0.001	0.003
25	9.037	0.000	0.001	0.003
28	9.035	0.002	0.002	0.003
31	9.035	0.000	0.001	0.002
35	9.035	0.000	0.002	0.003
41	9.034	0.001	0.001	0.003
45	9.035	0.000	0.003	0.003
51	9.035	0.001	0.001	0.003
55	9.036	0.001	0.002	0.003
61	9.037	0.003	0.003	0.003
65	9.039	0.0005	0.001	0.003
71	9.037	0.0035	0.004	0.006
75	9.037	0.001	0.002	0.003
85	9.039	0.001	0.001	0.002
95	9.041	0.000	0.000	0.001
105	9.041	0.002	0.003	0.003
115	9.041	0.003	0.003	0.003
127	9.046	0.000	0.001	0.001

W. S. STARRING,
Lieutenant of Ordnance.

The Ordnance Board convened under orders of the War Department, Special Order No. 129, of June 27, 1876.

FRANK H. PHIPPS,
Captain of Ordnance, Recorder.

TABLE 8.—*Results obtained with experimental powders fired from 8-inch rifles Nos. 1 and 5.*

No. of rounds.	Date of firing.	Powder.				Projectile.		Initial velocity.	Pressure per square inch of bore.	Recoil.	Elevation in degrees.
		Maker.	No. of grains to the pound.	Density.	Weight of charge.	Kind.	Weight.				
							Lbs.	*Feet.*	*Lbs.*	*Feet.*	
706	Oct. 23, 1875	Du Pont's hexagonal, E. V. G. I	72	1.750	35	Butler	170	1,472	31,500	3.71	— 1
707	Oct. 23, 1875	....do	72	1.750	35	....do	170	1,477	34,500	3.12	— 1
708	Oct. 23, 1875	....do	72	1.750	35	....do	170	1,478	33,500	3.35	— 1
709	Oct. 23, 1875	....do	72	1.750	35	....do	170	1,475	34,500	3.21	— 1
531	Nov. 23, 1876	Du Pont's sphero-hexagonal, H. A	123	1.750	30	....do	180	1,339	18,500	4.17	— 1
532	Nov. 23, 1876	....do	123	1.750	30	....do	180	1,380	21,000	3.17	— 1
533	Nov. 23, 1876	....do	123	1.750	35	....do	180	1,453	33,500	3.63	— 1
534	Nov. 23, 1876	....do	123	1.750	35	....do	180	1,433	29,000	3.58	— 1
535	Nov. 23, 1876	....do	123	1.750	35	....do	180	1,420	31,500	3.63	— 1
536	Nov. 23, 1876	Du Pont's sphero-hexagonal, H. C	123	1.730	30	....do	180	1,185	14,000	3.25	— 1
537	Nov. 23, 1876	....do	123	1.730	30	....do	180	1,187	11,000	3.17	— 1
538	Nov. 23, 1876	....do	123	7.730	35	....do	180	1,287	15,000	3.33	— 1
539	Nov. 23, 1876	Du Pont's sphero-hexagonal, H. B	123	1.720	30	....do	180	1,276	16,500	3.25	— 1
540	Nov. 23, 1876	....do	123	1.720	30	....do	180	1,271	16,500	3.42	— 1
541	Nov. 23, 1876	....do	123	1.720	35	....do	180	1,338	21,000	3.33	— 1
542	Nov. 23, 1876	....do	123	1.720	35	....do	180	1,344	14,000	3.42	— 1
543	Nov. 24, 1876	Du Pont's sphero-hexagonal, H. A	123	1.750	35	....do	180	1,400	37,500	3.42	— 1
575	May 19, 1877	Pigou, Wilks & Laurence, English pebble, P.13¼	140	1.7367	25	....do	180	Lost	17,000	4.25	— 1
576	May 19, 1877	....do	140	1.7367	35	....do	180	1,375	42,500	4.25	— 1
577	May 19, 1877	....do	140	1.7367	25	....do	180	1,236	20,500	4.25	— 1
578	May 19, 1877	....do	140	1.7367	35	....do	180	1,376	40,000	4.25	— 1
579	May 19, 1877	....do	140	1.7367	35	....do	180	1,381	32,500	4.25	— 1
580	May 19, 1877	Pigou, Wilks & Laurence, English pebble, P.13	140	1.7497	25	....do	180	1,223	26,500	4.25	— 1
581	May 19, 1877	....do	140	1.7497	35	....do	180	1,377	55,000	4.25	— 1
582	May 19, 1877	....do	140	1.7497	35	....do	175	1,411	58,500	4.25	— 1
583	May 26, 1877	Pigou, Wilks & Laurence, English pebble, P.13½	140	1.7568	35	....do	180	1,404	45,000	4.25	— 1
588	June 23, 1877	....do	140	1.7568	25	....do	175	1,184	27,500	4.25	— 1
589	June 23, 1877	....do	140	1.7568	35	....do	172	1,412	52,500	4.25	— 1
590	June 23, 1877	....do	140	1.7568	35	....do	172	1,395	51,000	4.25	— 1

TABLE 8.—*Results obtained with experimental powders fired from 8-inch rifles Nos. 1 and 5*—Continued.

AVERAGES.

No. of rounds.	Date of firing.	Powder. Maker.	Powder. No. of grains to the pound.	Powder. Density.	Powder. Weight of charge.	Projectile. Kind.	Projectile. Weight.	Initial velocity.	Pressure per square inch of bore.	Recoil.	Elevation in degrees.
							Lbs.	*Feet.*	*Lbs.*	*Feet.*	
4	.....	Du Pont's hexagonal, E. V. G. I	72	1.750	35	Butler	170	1,475	33,500	3.34	— 1
2	.....	Du Pont's sphero-hexagonal, H. A	123	1.75	30	....do	180	1,359	19,750	3.67	— 1¼
4	.....	....do	123	1.75	35	....do	180	1,428	32,875	3.56	— 1¼
2	.....	Du Pont's sphero-hexagonal, H. C	123	1.73	30	....do	180	1,186	12,500	3.21	— 1¼
1	.....	....do	123	1.73	35	....do	180	1,287	15,000	3.33	— 1¼
2	.....	Du Pont's sphero-hexagonal, H. B	123	1.72	30	....do	180	1,273	16,500	3.33	— 1¼
2	.....	....do	123	1.72	35	....do	180	1,341	17,500	3.37	— 1¼
2	.....	Pigou, Wilks & Laurence, English pebble, P.13½	140	1.7367	25	....do	180	1,236	18,750	4.25	— 1
3	.....	....do	140	1.7367	35	....do	180	1,377	38,333	4.25	— 1
1	.....	Pigou, Wilks & Laurence, English pebble, P.13	140	1.7497	25	....do	180	1,223	26,500	4.25	— 1
1	.....	....do	140	1.7497	35	....do	180	1,377	55,000	4.25	— 1
1	.....	....do	140	1.7497	35	....do	175	1,411	58,500	4.25	— 1
1	.....	Pigou, Wilks & Laurence, English pebble, P.13½	140	1.7568	25	....do	175	1,184	27,500	4.25	— 1
1	.....	....do	140	1.7568	35	....do	180	1,404	45,000	4.25	— 1
2	.....	....do	140	1.7568	35	....do	172	1,404	51,750	4.25	— 1

AVERAGE RESULTS OBTAINED WITH STANDARD POWDER.

157	.....	Du Pont's hexagonal, E. V	72	1.75	35	Butler	170	1,431	30,232	5.03	.....
5	.....	....do	72	1.75	35	....do	175	1,415	31,100	4.92	.....
20	.....	....do	72	1.75	35	....do	180	1,344	29,775	3.60	.....
16	.....	....do	72	1.75	35	....do	172	1,397	27,750	5.03	.....

TABLE 9.—*Results obtained with experimental powders fired from 9-inch rifle No. 4.*

[Averages.]

No. of rounds.	Date of firing.	Powder. Maker.	Powder. No. of grains to the pound.	Powder. Weight of charge.	Powder. Density.	Projectile. Kind.	Projectile. Weight.	Initial velocity.	Pressure per square inch of bore.	Elevation, in degrees.	Recoil.
				Lbs.			*Lbs.*	*Feet.*	*Lbs.*		*Feet.*
4	July 14, 1876	Laflin & Rand cubical	74	40	1.785	Butler	228	1,319	19,750	− 1	3.14
2	July 14, June 17, 1876.	Hazard cubical, A	56	40	1.765	do	229	1,436	24,750	− 1	5.33
2	do.	Hazard cubical, B	56	40	1.755	do	227	1,392	29,750	+ 1¼ & − 1¼	5.19
20	May 31, 1876	Du Pont's hexagonal, F. P. G. H	72	40	1.785	do	230	1,310	24,625	1¼	3.93
3	do.	do	72	40	1.785	Dana	229	1,311	25,000	1¼	3.95

Thirty-eight rounds fired from 9-inch rifle No. 3, using 40 pounds Du Pont's hexagonal, E. V. F. U., powder, and Butler projectiles of 231 pounds, gave an average initial velocity of 1,288 feet per second and 26,345 pounds pressure per square inch.

TABLE 10.—*Results obtained with experimental powders fired from 15-inch Rodman, smooth-bore.*

[Averages.]

No. of rounds.	Date of firing.	Powder				Projectile.		Initial velocity.	Pressure per square inch of bore.	Elevation, in degrees.	Recoil.	Counter-recoil.
		Maker.	No. of grains to the pound.	Density.	Weight of charge.	Kind.	Weight.					
					Lbs.		*Lbs.*	*Feet.*	*Lbs.*		*Feet.*	*Feet.*
3	Jan. 6, 1876	Du Pont's hexagonal, G Q	72	1.75	100	Solid round	453	1,542	20,334	1	8.71	1.42
1	Jan. 13, 1876	do	72	1.75	110	do	453	1,602	25,000	1	8.71	.....
2	Jan. 13, 1876	do	72	1.75	120	do	455	1,654	28,000	1	8.71	.....
3	Jan. 6, 1876	Du Pont's hexagonal, G. P	72	1.76	100	do	454	1,529	19,167	1	8.71	1.64
3	Jan. 6, 1876	Du Pont's hexagonal, G. O	72	1.77	100	do	453	1,513	17,500	1	8.71	1.89
3	Jan. 6, 1876	Du Pont's hexagonal, G. N	72	1.78	100	do	454	1,478	15,000	1	8.71	3.04
2	Jan. 13, 1876	do	72	1.78	120	do	450	1,576	19,500	1	8.71	.....
1	Feb. 22, 1876	Du Pont s hexagonal, G. V	72	1.74	80	do	450	1,378	21,000	Dep. 1 1/16	4.67	3.92
2	Feb. 22, 1876	do	72	1.74	100	do	454	1,535	23,750	Dep. 1 1/16	8.29	0.23
1	Feb. 22, 1876	do	72	1.74	110	do	454	1,606	39,000	Dep. 1 1/16	8.62	0.21
1	Feb. 22, 1876	Du Pont's hexagonal, G. W	72	1.73	80	do	450	1,459	25,000	Dep. 1 1/16	4.58	0.25
1	Feb. 22, 1876	do	72	1.73	100	do	452	1,602	32,500	Dep. 1 1/16	8.33	0.21
1	Jan. 26, 1876	Du Pont's hexagonal, F. P. G. H	72	1.785	110	do	453	1,467	11,000	Dep. 1 1/16	8.42	.....
1	Jan. 26, 1876	do	72	1.785	120	do	455	1,562	18,000	Dep. 1 1/16	8.67	.....
2	Feb. 22, 1876	Du Pont's hexagonal, R. V. C	72	1.75	100	do	452	1,532	33,000	Dep. 1 1/16	7.87	0.28
1	Jan. 6, 1876	Oriental hexagonal	85	1.755	50	do	453	1,081	5,000	Dep. 1 1/16	5.33	.....
1	Jan. 6, 1876	do	85	1.755	70	do	456	1,290	14,000	Dep. 1 1/16	8.67	8.60
3	Aug. 30 and Oct. 25, 1876.	do	85	1.755	80	do	454	1,376	31,833	Dep. 1 1/16	7.16	.....
1	Jan. 6, 1876	do	85	1.755	90	do	454	1,473	21,000	Dep. 1 1/16	8.67	3.30
9	Jan. 6, Feb. 22, and Aug. 30, 1876.	do	85	1.755	100	do	452	1,487	25,900	Dep. 1 1/16	8.29	1.45
1	Aug. 30, 1876	do	85	1.755	120	do	453	1,593	42,500	Dep. 1 1/16	8.83	.....
3	June 17 and Aug. 30, 1876.	Hazard's cubical, A	56	1.765	100	do	448	1,554	20,833	Dep. 1 1/16	8.83	.....
2	Aug. 30, 1876	do	56	1.765	110	do	454	1,624	14,000	Dep. 1 1/16	8.88	.....
3	Aug. 30, 1876	do	56	1.765	120	do	452	1,676	25,166	Dep. 1 1/16	.....	.....
1	June 17, 1876	Hazard's cubical, B	56	1.755	100	do	449	1,524	16,000	Dep. 1 1/16	.....	.....
1	June 17, 1876	do	56	1.755	120	do	458	1,623	15,000	Dep. 1 1/16	.....	.....
1	July 14, 1876	Laflin & Rand	74	1.785	100	do	449	1,433	11,000	Dep. 1 1/16	8.13	.....
2	July 14, 1876	Waffle	74	1.785	120	do	455	1,570	16,000	Dep. 1 1/16	8.67	.....

TABLE 10.—*Results obtained with experimental powders fired from* 15-*inch Rodman, smooth-bore*—Continued.

Standard.

No. of rounds.	Date of firing.	Powder.				Projectile.		Initial velocity.	Pressure per square inch of bore.	Elevation, in degrees.	Recoil.	Counter-recoil.
		Maker.	No. of grains to the pound.	Density.	Weight of charge.	Kind.	Weight.					
					Lbs.		*Lbs.*	*Feet.*	*Lbs.*		*Feet.*	*Feet.*
14	.....	Du Pont's hexagonal, E. V	72	1. 75	100	.....do	450	1, 594	18, 964	.....	.....	.....
3	.....	.....do	72	1. 75	120	.....do	450	1, 696	22, 000	.....	.....	.....
1	.....	.....do	72	1. 75	125	.....do	450	1, 735	22, 000	.....	.....	.....

APPENDIX R.

Construction of a breech-loading rifled howitzer, caliber 6 inches.

OFFICE OF THE CONSTRUCTOR OF ORDNANCE, U. S. ARMY,
New York City, June 18, 1877.

SIR: I have the honor to submit herewith, report of the construction of the 6-inch Moffatt breech-loading rifled howitzer.

Very respectfully, your obedient servant,

S. CRISPIN,
Bvt. Col., U. S. A. Lt. Col. of Ordnance,
Constructor of Ordnance.

The CHIEF OF ORDNANCE, U. S. A.,
Washington, D. C.

The Moffatt 6-inch breech-loading rifled howitzer.

In consideration of the satisfactory results obtained with the 3.07-inch Moffatt breech-loading field-piece, as tested under the supervision of this office, and also of the evident advantages to be secured by the substitution of a breech-loading rifled howitzer for the present 8-inch muzzle-loading smooth-bore howitzer, of at least equal power to the latter gun—for flank defense and siege purposes—a result believed to be attainable with this system by a 6-inch caliber, it was decided to construct such a howitzer on the Moffatt plan for experiments and tests, under the provisions of the act of June 23, 1874, appropriating $10,000 for "the purpose of continuing experiments on breech-loading cannon."

The piece was manufactured at the South Boston foundry under instructions from this office, Mr. Moffatt, the inventor, having the immediate supervision of the work. It was completed in June 1876, and was sent to Sandy Hook, New York Harbor, for experiments and tests, under the direction of The Ordnance Board.

DESCRIPTION OF THE HOWITZER.

The 6-inch howitzer is devised upon the same plan as the 3.07-inch Moffatt breech-loading field-piece; the slight changes in construction resulting either from some observed imperfection in the working of the mechanism in the field-piece or from the employment of a different nature of ammunition in the howitzer. A brief description here will therefore suffice.

Plate I, Figs. 1 and 2.—The howitzer consists of a steel body A, to which is adapted the Moffatt breech-mechanism, a conical breech-plug closing the bottom of the bore through the agency of a strap or yoke S, which locks into lugs on the sides of the breech for the support necessary to resist the shock of discharge, and which is attached to the trunnions as an axis of motion. The chamber is opened by tilting up the breech of the howitzer with a lever D, whereby the block falls back upon the strap and uncovers the bore. In place of a leather strap to insure the opening of the breech, a heel F is attached to the hinge of the breech-block, which, coming in contact with the strap as the breech is raised, throws down the block, and by the same movement turns with

the hinge so as to clear the strap. The locking-bolt is bored through axially for the reception of a firing-pin P, with which to explode the charge when primed metallic cartridges are employed. An ordinary vent is also provided by means of which the charge can be ignited by a friction-primer.

RIFLING AND CHAMBERING.

The rifling consists of seventeen lands and grooves each.

Width of lands	0.50 inches.
Width of grooves	0.6088 inch.
Depth of grooves	0.075 inch.

Twist uniform, one turn in 30 feet.

The chamber is conical in form and concentric with the bore.

Length of chamber to top of bevel	5 inches.
Maximum diameter	6.2 inches.

Minimum diameter, same as the bore through grooves.

Capacity of chamber, 4 pounds of powder.

CARTRIDGE-CASES.

Plate II, Figs. 4 and 5.—The case for use of friction-primers is of metal, brass or tin, re-enforced by a cup of tin at the bottom. The bottom is of block-tin, and perforated through the center for the passage of the flame from the vent. A bar of tin covers this perforation on the inside of the case, and in such manner as to allow the entrance of the flame from the vent, while it cuts off the exit of the gases of discharge. By this means, the loss of gas through the vent and the wear of the vent is avoided. No primed metallic cartridges have, as yet, been submitted for trial. An ejector-spring is attached to the breech-block, which, catching under the flange of the cartridge-case as the breech is closed, throws out the case when the breech is opened.

PROJECTILE.

The projectiles provided for trial with this howitzer are shown on Plate II.

Fig. 1, represents a case-shot, and Fig. 2 a shell, both being fitted with the Butler sabot to communicate rotation; Fig. 3 represents a canister-shot.

Weight of unloaded shell	60 pounds.
Weight of loaded shell	pounds.
Weight of case-shot	65 pounds.
Weight of canister-shot	45 pounds.

CARRIAGE.

The howitzer is mounted on a service 24-pounder siege-carriage.

FABRICATION OF THE GUN.

The gun-body was made from a steel block furnished by Thomas Firth & Sons, of Sheffield, England. It was cast in an ingot, forged to dimensions, and bored by them to within one-quarter inch of its finished

diameter. The steel contained about 0.64 of 1 per cent. of carbon. The breech-strap and block were made in Boston, and were of low steel, containing 0.44 of 1 per cent. of carbon.

INSPECTION.

The gun upon completion was inspected and accepted as satisfactory.

PRINCIPAL DIMENSIONS.

Diameter of bore across lands	6 inches.
Diameter of bore through grooves	6.15 inches.
Diameter of bore through chamber	6.2 inches.
Diameter of breech-block cavity at seat of gas-check	6.8 inches.
Diameter of breech-block cavity at outer edge	8.5 inches.
Exterior diameter of piece at muzzle	12 inches.
Maximum diameter	16 inches.
Diameter of trunnions	5.875 inches.
Diameter of rimbases	8.6 inches.
Distance between rimbases	16 inches.
Diameter of loop (over trunnions) in breech-straps { vertical	5.875 inches.
Diameter of loop (over trunnions) in breech-straps { horizontal	6.075 inches.
Length of gun body	78 inches.
Total length of gun	88 inches.
Length of bore	69.625 inches.
Length of rifled portion of bore	64.625 inches.
Length of chamber to top of bevel	5 inches.
Length of bevel joining lands to chamber	1 inch.
Pitch of rifling, uniform, one turn in	30 feet.
Number of grooves and lands, each	17
Width of lands	0.50 inch.
Width of grooves	0.6088 inch.
Depth of grooves	0.075 inch.
Length of trunnions	5.875 inch.
Weight of gun	pounds.

S. CRISPIN,
Bvt. Col., U. S. A., Lieut. Col. of Ordnance,
Constructor of Ordnance.

UNITED STATES ORDNANCE AGENCY,
New York, June 18, 1877.

6 INCH MOFFATT B. L. FLANK DEFENCE STEEL HOWITZER.

Fig I.

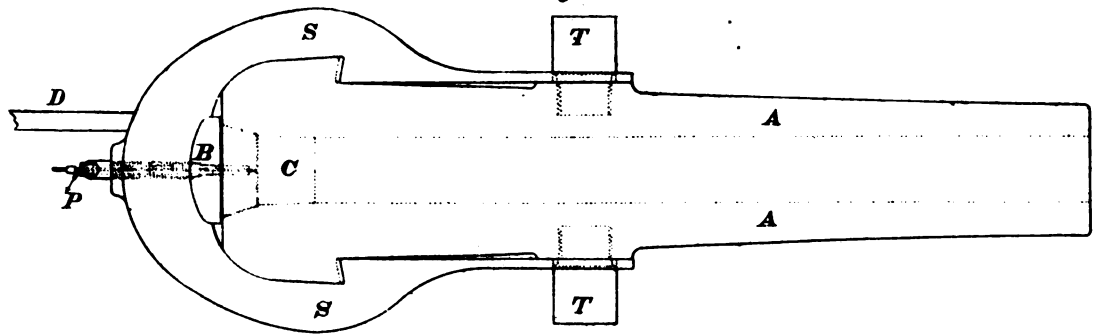
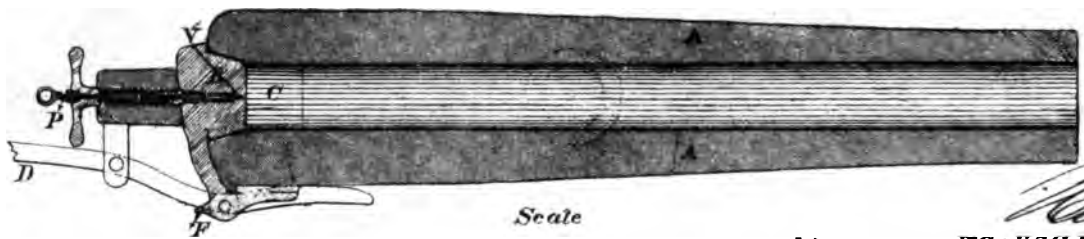


Fig II.



Scale

Inches.

Accompanying Report of The Ordnance Board—Appendix R. 1877.

PLATE I.

F^Col. U.S.O.L^t Col. of Ordnance.
Constructor of Ordnance.

APPENDIX S.

Construction of Dean's patent bronze gun; caliber, 3½ inches.

OFFICE OF THE CONSTRUCTOR OF ORDNANCE,
New York City, August 7, 1877.

SIR: I have the honor to transmit herewith report of the construction of the 3.5-inch bronze muzzle-loading field-piece, (Dean's patent.)

Very respectfully, your obedient servant,

S. CRISPIN,
Bvt. Col., U. S. A., Lieutenant-Colonel of Ordnance,
Constructor of Ordnance.

The CHIEF OF ORDNANCE, U. S. A.,
Washington, D. C.

The 3.5-inch bronze muzzle-loading field-piece, (Dean's patent.)

The 3.5-inch bronze muzzle-loading field-piece, (Dean's patent,) constructed in accordance with the recommendation of the board of experimental guns, &c., June 22, 1876, which was as follows:

"The board recommends the construction of one field or siege rifle, the kind and caliber to be hereafter determined by the board, and after correspondence with the founders as to their present plant for construction, &c., the bronze to be furnished by the United States Government."

The 3.5-inch bronze rifled field-gun, (Dean's patent.)

This gun was manufactured at the foundry of the South Boston Iron Company, under the supervision of the patentee, Mr. Samuel D. Dean, and in conformity with an order from the constructor of ordnance dated August 23, 1876. It was completed and accepted about April 21, 1877.

DESCRIPTION.

Plate I.—The gun is constructed on the plan of the 3.5-inch Rodman muzzle-loading rifle, model 1870. It is without preponderance. Its length and weight are very nearly the same as those of the light 12-pounder, and it is adapted to the same carriage. The main peculiarity in its construction consists in the application of Mr. Dean's patent process for condensing and hardening the metal of the bore.

RIFLING AND VENTING.

The rifling consists of seven lands and grooves each. The lands are 0.50 inch in width. The grooves are 1.07-inches in width and 0.075 inch in depth. The twist is uniform, making one turn in 12 feet. The vent is in the normal position, on the top of the gun.

FABRICATION.

The gun was cast solid in a cast-iron flask or "chill" about 3½ inches thick, the interior surface being covered with a slight coating of clay and sand. It was found necessary to make two castings, as the first one proved to be defective. The metal used consisted of three old bronze 6-pounders furnished by the Ordnance Department and a part of a bronze 12-pounder on hand at the foundry. At the second casting the metal of the rejected piece was returned to the furnace, with the exception of a section reserved for tests, and another part of the 12-pounder was added to supply the deficiency. The weight of the charge of metal was 3,364 pounds, the time of melting 1 hour 50 minutes, and time of fusion 1 hour 10 minutes. The gun was removed from the flask 18 hours after casting, and when thoroughly cooled was placed in a lathe and the sinking head cut off. It was next bored out in a boring-machine to a diameter of 3.37 inches.

Plate II.—To condense the metal of the bore the gun was then inclosed in the iron flask in which it was cast, and was placed in the condensing-machine and firmly secured by heavy iron rods. Six mandrels, varying in diameter from 3.42 inches to 3.50 inches, were used in the operation. These, by means of a hydraulic press of 10-inch bore, were in the order of their size successively forced down the bore of the piece and withdrawn, and the operation was repeated until the most of the resilience of the metal had been overcome and the bore enlarged to very nearly 3.50 inches in diameter. The pressures used varied from 500 to 2,400 pounds per square inch—making a total pressure of from 19½ to 94 tons.

After condensing the bore the gun was removed to the rifling-machine and rifled, the grooves being planed out to a little less than the required depth. It was then put back in the condensing-machine and the bore still further enlarged by means of an expanding mandrel so constructed as to follow the opposite lands and grooves. On account of a slight error in the width of the rifling-tool, the grooves were left too narrow for the ribs of the mandrel, and consequently the edges of the lands were slightly abraded in the operation. A little grinding with fine emery removed much of the rough edge left upon the lands, but did not wholly restore the smoothness desired.

In this connection it should be stated that the condensing process was only applied to the cylindrical portion of the bore, and consequently the metal at the bottom was left in its ordinary condition. The gun was next turned down in lathes to its prescribed exterior dimensions and a copper vent-piece inserted.

TESTS.

Two specimens, one from the outside and one from near the center, were taken from the sinking head next to the muzzle and tested for tenacity and density, with the following results:

	Tenacity.	Density.
Outside specimen	48,230	8.6663
Inside specimen	34,706	8.5651

To test the effect of the condensing process upon the physical properties of the metal, a section taken from the first casting was bored out and condensed in the same manner as the bore of the gun. A ring was then cut off and turned down to 0.133 inch in thickness and tested for density. For hardness two specimens were tested, one taken from the

hardened bore and one from the outside. A specimen for tenacity taken from the hardened portion was also tested.

The following results were obtained:

Density of ring	8.7065
Hardness of unhardened specimen	1.4049
Hardness of condensed specimen	5.1158
Tenacity of condensed specimen	51,571

The comparisons for hardness are with wrought copper as 1.

An inside specimen, uncondensed, from the same block gave the following results:

Density	8.3512
Tenacity	35,810

INSPECTION.

The gun was duly inspected when completed and was accepted as satisfactory. The following were the principal dimensions:

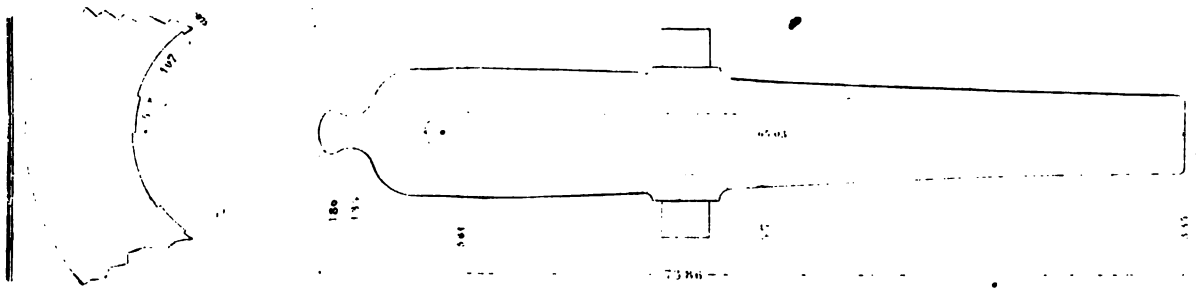
Exterior diameter at the muzzle	6.70 inches.
Exterior diameter 12 inches from muzzle	7.12 inches.
Exterior diameter 24 inches from muzzle	8.01 inches.
Exterior diameter 36 inches from muzzle	9.42 inches.
Exterior diameter 48 inches from muzzle	10.69 inches.
Exterior diameter 54 inches from muzzle	11.04 inches.
Exterior diameter 60 inches from muzzle	11.18 inches.
Exterior diameter 62 inches from muzzle, (maximum)	11.22 inches.
Exterior diameter 65 inches from muzzle	11.05 inches.
Diameter of knob of cascabel	3.75 inches.
Diameter of neck of cascabel	2.68 inches.
Diameter of trunnions	4.2 inches.
Diameter of rimbases	5.68 inches.
Length of trunnions, { right	3.23 inches.
Length of trunnions, { left	3.24 inches.
Distance between rimbases	11.05 inches.
Width of grooves	1.07 inches.
Depth of grooves	0.075 inches.
Width of lands	0.5 inches.
Twist of rifling	144 inches.
Length of bore	65.03 inches.
Length of rifling	60.378 inches.
Axis of vent from bottom of bore	1.46 inches.
Total length of piece	73.86 inches.
Weight	1,322 pounds.

The gun was sent to Sandy Hook May 25, 1877, for proof and trial.

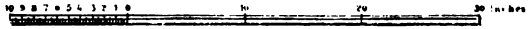
S. CRISPIN,
Bvt. Col., U. S. A., Lieutenant-Colonel of Ordnance,
Constructor of Ordnance.

UNITED STATES ORDNANCE AGENCY,
New York City, August 7, 1877.

3½" M L BRONZE GUN (DEANS PATENT)



No preponderance
Twist uniform one turn in 5 feet
7 Grooves and lands
Weight - 1572 lbs



Brv. Col. U.S.A. Lt. Col. of Ordnance
Constructor of Ordnance

PLATE 1

which afford the supports for plain wrought-iron rollers running on a broad flat traverse-circle on the platform. Two additional sets of forks with grooved wheels, running on racers adapted to the grooved wheels, complete the connection of the system with its emplacement.

It will be seen that the force of the discharge is contemplated to be borne by the pintle and the two sets of grooved wheels, thus distributing the strains over the entire extent of the foundations.

The traversing arrangement contemplates that the plain front wheels and two large eccentric wheels, placed at the immediate rear of the carriage, together with the pintle as a center, shall accomplish the work. The eccentrics are worked by a ratchet-wheel and lever, so arranged as to secure a continuous back and forward motion in lieu of the old system of levers and sockets, which required the removal of the lever from socket to socket.

As the gun is traversed when the upper carriage is in battery, and, consequently, the weight almost altogether over the front wheels, it will be seen that the throwing-in gear of the eccentrics and the working of the traverse-wheels will be comparatively easy. The eccentric throw of these wheels is sufficient to free the intermediate grooved wheels from their circles, and thus prevent any binding on their part in the operation of traverse. The ordinary circular rack with its pinion and crank gives motion to the traverse-wheels.

ARRANGEMENT FOR CHECKING RECOIL.

This is accomplished by means of a hydraulic buffer, 9 inches in the interior diameter of the cylinder and of sufficient length to secure 7 feet of recoil. This attachment is made to the carriage in the same manner, and the general details are the same as attained in the one attached by this office to the carriage at Fort Wadsworth, and successfully tried. (See report from this office dated July 16, 1874.)

The only important change is the attachment of the piston-rod to the upper carriage; instead of the ordinary cross-transom at the rear of the carriage, a powerful fork is bolted to the bottom of the carriage. The fork is slit so as to permit the carriage to rise without carrying up with it the piston-rod, and thus rendering it liable to bend when the carriage recoils. The piston-rod has an eye-bolt at its end, through which passes a strong steel bolt, which passes through the slot in the fork. This secures rolling friction between the rod and fork. The inclination of the chassis rail is 4°. About one foot from the rear end of the bottom transom of the top carriage an incline-plane or wedge is bolted to the top of each rail, and continues somewhat beyond the counter-hurters. It has an inclination of 2.5°.

The upper carriage is provided with two sets of wheels, front and rear, placed between the cheek-plates of the carriage-cheeks. The rear wheels have eccentrics, to be used for drill purposes. These are not used in firing. The front wheels are arranged as in the ordinary 15-inch carriage, the wheels not coming in contact with the rail until the carriage commences to ascend the inclined plane in the act of recoil. The rear wheels are not in contact until they reach the inclined plane.

It will be seen from the above that the carriage starts on sliding friction, and, after a distance of about one foot, finishes the remainder of its recoil on rolling friction, the ascent of the inclined plane absorbing a considerable portion of the recoil. Of course the carriage would run in battery if means were not provided to retain it in a fixed position. For this purpose two sets of couplings are used, one set permanently fixed to the bottom transom of the upper carriage, and the other set to the side of the chassis-rails. The latter are hinged, and are

moved, when it is desired to release the gun, by means of suitable levers conveniently placed on the outside of the chassis-rails. The gun is loaded in this position, the muzzle being depressed by the elevating and depressing apparatus until the muzzle is sufficiently below the parapet. When loaded and sufficiently elevated above the crest, the levers above referred to are operated upon so as to throw the catches or couplings of the chassis out of gear with the similar parts attached to the upper carriage. The gun and carriage, being on an inclined plane and free to move, runs promptly into battery. It will be seen that this arrangement dispenses with the ordinary eccentric movement necessary in our present carriage in running into battery; also provides means for holding the gun always in the same position each time for loading. The ordinary crane and deferential pulley are used for loading. (See drawing.)

ELEVATING AND DEPRESSING.

The arrangement for this purpose is similar to that employed in experiments with 8-inch converted gun No. 1. It consists of two circular racks, each supplied with two pinions, one geared and one lever wheel. The position of the apparatus will be seen in the drawing; also its mode of attachment to the gun. The front of the rack is also toothed, and a pinion working in it communicates with a dial-plate and point, (situated on the outside of the carriage-cheeks,) and thus enables us to read the elevation from the dial. For drill purposes, running the gun out of battery only, ordinary blocks and tackle, with compound gear, are used. The eccentrics of the upper carriage are used on these occasions, so that it may be constantly on rolling friction. The drawings are sufficiently full in these regards to render unnecessary any additional explanation.

Steps and rails are placed about the carriage, so as to make access to all parts necessary to be reached convenient and prompt.

ARRANGEMENTS FOR LOADING.

The exposed position of the barbette battery slopes render it impracticable to adopt any system contemplating loading from the parapets. This should only be attempted under extraordinary circumstances. Accordingly the subject of loading under cover, using our present emplacements and present system of carriages, has received attentive consideration. Depressing the muzzle so as to place it, say, two feet under cover of the parapet, and then loading with a simple and well-protected apparatus, worked almost immediately in contact with the parapet-wall, thus giving the most protection practicable for the gunners, seems to offer an improvement well worth consideration and trial. The necessary space between the muzzle and parapet must be secured. This it is proposed to obtain by using our present pintle without change of location, but dispensing with the present steps now used for mounting the parapet, and making the parapet walls the same as now exists between the emplacements of 15-inch guns. (See Plate II, Fig. 1.) This will cost but little, it is believed, and will secure about 6 feet between the muzzle of the gun, in the position for loading, and the parapet-wall, a space sufficient for handling and inserting the cartridge and shot and for the easy working of the power designed to move the rammer. Rammers, it is intended, shall be placed in small iron tubes, 5 inches in diameter and 14 feet long, inserted into the parapet, either three or six in number, making proper angles with the crest and occupying suitable positions in it for loading at different points for different arcs of traverse. (See drawings.) These rammers, made of flexible wood, are to have iron racks on their under

sides, and are worked in and out of the bore of the gun by simple pinions working in the racks, operated upon by cranks.

The raising of the shot is done either by a crane and differential pulley or any simple device for raising, placed in front of the pintle. The loading, it will be seen, will be done completely under cover. The gun will have to be depressed to an angle of $14\frac{1}{2}°$ to secure the necessary cover. This, it is believed from theory and practice, will not be so great as to cause sliding of the projectile, as the co-efficient of friction for rough surfaces allows at least this inclination. The power necessary to be exercised in moving the projectile from the muzzle to its seat will not at this angle exceed 300 pounds for a 700-pound projectile; and it can easily be calculated that a pinion (2-inch radius) with a 15-inch crank can, with an effort of, say, 40 pounds at the crank, do the work of loading the projectile easily and in a short time, say 30 seconds. (See drawings for positions and dimensions of rammer-staffs, cranks, and pinions.)

It will be seen that in firing at moving objects, different rammer-staffs in the parapet-wall will come into play, dependent upon the required angle of fire, (horizontally.) At no time can this exceed 12 feet of traverse, using only three rammers to each gun measured on the traverse-circle, and this, it is estimated, can be accomplished in, say, 10 seconds. The whole traverse of 120° can be made in 40 seconds.

The depression of the gun from the highest angle to one of loading will occupy 30 seconds.

The rammer-heads will be of sheet-iron, easily detached from the rammer-staff; and when required the sponges can replace them on the staff.

The men traversing, it will be seen on examination, will be comparatively well protected; both by the sufficient vertical distance between the platform and crest at this point, and by the earthen traverses on the sides of the gun and carriage.

The operations of elevating and depressing can be made comparatively secure, but the pointing and priming remain as at present in our barbette system of serving heavy guns.

The alterations in the platform exhibited (see Plate III) are made to suit our carriages as at present contemplated; and the wooden platform, which will be used in our experiments and tests with the 12-inch gun and its carriage, will be built in conformity therewith; but what will be the best arrangement in this regard, provided this system of carriage is adopted for our present works now suitable for the same, is not my province to discuss.

It is believed that the above plan is simple, feasible, and economical, and will, at a moderate cost, secure as much cover as can be afforded to gunners maneuvering and loading, especially the latter operation, where we have our present system of barbette batteries, exposing, as now arranged, our guns and present system of carriages above the parapets.

It is contemplated to test the system practically, as it can be done, when we test the 12-inch rifle, at so moderate cost as to be of no material account. This plan, of course, only meets the present conditions existing in the construction of carriages and barbette batteries, an important consideration for the present; but our future improvements and changes, both in the systems of fortifications and guns, will have to be met by the provisions of carriage systems adapted to such changes as progress may demand.

S. CRISPIN,
Bvt. Col. U. S. A., Lieutenant-Colonel of Ordnance,
Constructor of Ordnance.

voir or basin for mixing the charge; thence two runners extended to the flask connecting with side runners on opposite sides and at points about 4 feet 8 inches from the top, which was as high as the flow of metal from the furnaces could reach. To fill the flask above this height, it was arranged that a portion of the charge of one of the furnaces should be drawn off into ladles to be poured in at the top.

CASTING.

The fires were kindled in furnaces Nos. 2 and 3 at 3.30 a. m., and in No. 1 at 4 a. m., May 30, 1877. The metal was down in all the furnaces by 12.30 p. m., though No. 1 preceded the others by fully half an hour, on account of being more advantageously located for feeding the fires. Tests of the metal in fusion were made at various intervals. At 4.40 p. m. it was found to be in proper condition in all the furnaces and they were tapped simultaneously. In 15 minutes the mold was filled to the level of the runners from the basin. The flow of metal from the furnaces was then stopped and the connecting apertures closed. Two large ladles of metal, which had meanwhile been drawn from one of the furnaces, were quickly poured in at the top of the flask, which filled it to within 20 inches of the surface. The remaining space was filled by adding three small ladles of metal, the last one being poured at 5.45 p. m. It was found, however, the next morning, that the surface of the casting had sunk several inches during the night and more metal was then added.

COOLING.

The water was let into the core-barrel at the same moment that the furnaces were tapped and circulated for 42 minutes at the rate of 60 gallons per minute. It was then diminished to 36 gallons per minute, at which rate the circulation was continued until shut off for the purpose of withdrawing the core-barrel. Fires were lighted in the pit at 6.06 p. m., and were kept burning for about 60 hours. The flow of water was stopped 24 hours after casting and the core-barrel removed. The water was then injected into the gun, and after a short interval the rate of circulation was fixed at 26 gallons per minute and continued until 118½ hours after casting, when it was shut off, excepting a small stream of half a gallon per minute, which was allowed to circulate for 14½ hours longer. The details of the cooling are given in the "statement of fabrication" hereto appended.

TURNING AND BORING.

When the gun had become thoroughly cooled, the flask was removed, and the outside cleaned of as much of the scale as came off readily. The hoisting from the pit was attended with some delay and difficulty, as the foundry-cranes were too light for the purpose, and additional hoisting machinery had to be erected temporarily. It was finally accomplished on the twelfth day after casting, and the gun was lowered upon skids alongside the pit. The remainder of the scale was chipped off from the exterior, and the bore was cleaned, as far as practicable, after being treated with a solution of diluted sulphuric acid to soften the scale. The gun was then transferred to the machine-shop and placed in the heading-lathe. While in this machine, the greater portion of the superfluous metal of the chase was removed by cutting in at short intervals to within 2 or 3 inches of the required diameter, and then breaking out

the intervening rings with chisel and hammer. A ring for testing purposes—3½ inches thick—was cut next to the muzzle, and, as soon as work upon the chase was sufficiently advanced, was detached, together with the sinking-head.

The gun was next transferred to a boring-lathe, where the operations of boring and turning could be carried on at the same time. It is still in this machine at the date of the present writing, (August 27.) The work has not yet progressed far enough to give a positive assurance that the casting is sound throughout; but, as far as can be seen, there are no defects so serious as to impair its serviceability, nor are any apprehended.

TESTS.

The ring taken from next the muzzle of the gun was tested for initial tension, and specimens were afterward taken out for ascertaining the tenacity and density of the metal. The results are given in the "statement of fabrication" appended.

The metal of the ring in several places was quite spongy—indicating an insufficient length and weight of sinking-head—and considerable difficulty was experienced on this account in securing suitable specimens for the tests. The ring was taken from that part of the casting where the metal was poured in from ladles, (and consequently was somewhat cooled.) It is not certain, therefore, that the specimens taken from it correctly indicate the physical properties of the metal in the gun which came direct from the furnaces. An outside specimen, taken from the gun 19 inches from the muzzle, was tested, and gave results materially different from the specimens taken from the ring. (See table in statement of fabrication.)

THE TUBE.

The tube was manufactured at the works of Sir William Armstrong, at Newcastle-upon-Tyne, England. It is of coiled wrought iron, and made upon the same plan as those used in the conversion of the 10-inch Rodman smooth-bores into 8-inch rifles. It was bored up to an interior diameter of 12″.227 in order to remove a defect found in the bore while in process of manufacture.

The exterior diameter of the rough tube is 20″.11, and the length 240″.1. It has been subjected with satisfactory results to a water-proof of 375 pounds per square inch, and is, so far as can be judged, of good workmanship throughout.

Statement of fabrication of ordnance, for the service of the United States, by the South Boston Iron Company, at the South Foundry, under the supervision of Capt. Cullen Bryant, Ordnance Department, 12-inch cast-iron rifle-gun, lined with coiled wrought-iron tube, cast May 30, 1877.

CHARGE.

IRON USED.

Grade of iron.	Furnaces.			
	No. 1.	No. 2.	No. 3.	Total.
No. 1	15,000	15,000	15,000	45,000
No. 2	15,000	15,000	15,000	45,000
No. 3, hard	15,000	15,000	15,000	45,000
No. 3, soft				
Remelted	15,800	15,800	15,800	47,400
	60,800	60,800	60,800	182,400

COAL CONSUMED.

	Furnaces.			
	No. 1.	No. 2.	No. 3.	Total.
Melting				57,000
Fusion				27,000
				84,000

CHARACTER OF TEST-STICKS.

	Furnaces.			
	No. 1.	No. 2.	No. 3.	Basin.
Iron	Nearly white.	Mottled.	Slightly mottled.	None taken.

RECORD OF CASTING.

	May 30.
Furnaces fired at	3.30 and 4.00 a. m.
Metal down at	12.30 p. m.
Time of melting	9 hours.
Time in fusion	4½ hours.
Gun cast at	4.40 p. m.
Time occupied in casting	15 minutes.
Temperature of water entering core-barrel	62 degrees.
Temperature of water leaving core-barrel, (45 minutes)	113 degrees.
Rate of water per minute	36 gallons.
Fire kindled in pit	6.06 p. m.
	June 2.
Fire in pit went out	6.00 a. m.
Fire in pit burned	60 hours.
	May 31.
Water shut off at	5.00 p. m.
Core-barrel removed at	6.45 p. m.
Water entered gun at	6.57 p. m.
Temperature of water entering gun	64 degrees.
Temperature of water leaving gun in 13 minutes	136 degrees.
Total time in cooling gun	119¼ hours.

COOLING-TABLES.

Core-barrel.				Core-barrel removed.															
Hours.	Degrees.	Hours.	Degrees.	Hours.	Degrees.	Hours.	Degrees.	Hours.	Degrees.	Hours.	Degrees.	Hours.	Degrees.	Hours.	Degrees.	Hours.	Degrees.	Hours.	Degrees.
1	110	12	100	23	84	34	134	45	129	56	110	67	87	78	76	89	72	100	70
2	106	13	100	24	83	35	140	46	128	57	105	68	85	79	76	90	72	101	70
3	104	14	100	25	.....	36	142	47	127	58	101	69	84	80	75	91	70	102	70
4	102	15	100	26	.....	37	144	48	126	59	99	70	83	81	75	92	70	103	70
5	100	16	99	27	185	38	146	49	126	60	97	71	81	82	75	93	70	104	70
6	98	17	90	28	179	39	143	50	125	61	95	72	81	83	75	94	70	105	70
7	100	18	90	29	169	40	138	51	123	62	93	73	81	84	75	95	70	106	69
8	100	19	89	30	159	41	136	52	121	63	92	74	80	85	74	96	70	107	69
9	100	20	88	31	150	42	134	53	119	64	91	75	79	86	74	97	70	108	69
10	100	21	87	32	146	43	132	54	117	65	89	76	78	87	74	98	70	109	68
11	102	22	86	33	139	44	131	55	114	66	88	77	78	88	74	99	70	110	68

MECHANICAL TESTS.

Specimens.	Density.	Tenacity.
No. 6, (outside)*	7.3454	39,900
No. 5, (middle)*	7.2717	33,000
No. 4, (inside)*	7.2731	30,000
No. 3, (outside)†	7.3374	40,794
No. 8, (middle)†	7.2698	34,346
No. 1, (inside)†	7.3155	40,704
Radial specimen‡	7.2728	33,881

*Specimen taken from outside of gun at about 19 inches from muzzle.
†Specimens tested at the United States ordnance agency.
‡Specimens tested at the foundry.

INITIAL TENSION.

Exterior diameter of ring.	Interior diameter of ring.	Thickness of ring.	Thickness of broken section.	Interior opening.	Exterior opening.	Circumference of exterior of ring.	Exterior per inch of circumferences.	Initial tension.	Ratio of initial tension to tenacity.
49″.00	17″.75	3″.54	0″.58	0″.068	0″.184	153″.938	0″.001195	19,500	.....

REMARKS.—Equal quantities of Dover and Muirkirk iron were used in charging the furnace. Record of coal consumed was not kept for the different furnaces. Furnaces Nos. 2 and 3 fired at 3.30; No. 1 at 4 a. m. Cooling-tables represent the temperature at which the water left the core-barrel and gun. Temperature was at 68° when the water was shut off.

Preliminary experiments and tests.

Previous to casting the gun-casing, a number of experimental castings were made and tested with a view to determine the proper quality of iron to be employed. This course was necessary in order to provide a substitute for the Richmond pig-iron, which can no longer be procured of suitable quality for gun-construction. The most satisfactory results in these experiments were obtained from a mixture of equal quantities of Dover and Muirkirk pig-iron.

A "trial-cylinder" (Plate II) of the same form and dimensions as those described in Captain Rodman's Experiments on Metals for Cannon (pp. 225 and 226) was then cast from this mixture. This cylinder was cut up in the same manner as those above referred to and was subjected to a similar series of tests for the purpose of determining the physical properties of the metal. The results obtained from these tests were satisfactory, and it was decided to use a similar mixture for the gun-casing.

The Dover is made at Chatham, Columbia County, New York, being smelted with charcoal from a brown hematite ore found a few miles south of Dover Plains, Dutchess County, New York. This ore is mined in a wide vein, and is of two kinds, there being two lines of deposit in the stratum. One is a rich, solid ore, yielding from 48 to 55 per cent. of iron; the other yields from 38 to 42 per cent. In smelting the iron, the two kinds of ore are used in nearly equal proportions, it having been found that such a mixture gave the best results.

The Muirkirk iron is made with charcoal at Muirkirk, Prince George's County, Maryland.

The ore used is a nodular carbonate of iron from the Tertiary sands of the western shore of Chesapeake Bay. It is more or less altered into

sesquioxide of iron by the action of surface water, and is cleaned and roasted before charging the furnace.

The yield of iron from the raw ore is from 40 to 45 per cent., and from the roasted about 50 per cent.

Both of these irons have been used at the South Boston Foundry for a number of years and with excellent results, but have not heretofore been employed for ordnance purposes.

S. CRISPIN,
Bvt. Col. U. S. A., Lieut. Col. of Ordnance,
Constructor of Ordnance.

Mechanical tests of trial cylinder for 12-inch rifle.—Cast at South Boston Foundry, March 19, 1877, in a dry-sand mold.

COMPOSITION OF IRON USED IN THE CYLINDER.

Dover, No. 1, Muirkirk, No. 1, 900 pounds each	1,800 pounds.
Dover, No. 2, Muirkirk, No. 2, 900 pounds each	1,800 "
Dover, No. 3, Muirkirk, No. 3, 900 pounds each	1,800 "
Dover and Muirkirk remelted, 900 pounds each	1,800 "
Total	7,200 "

DIMENSIONS OF CYLINDER.

Height, 72 inches; 10 inches allowed for sinking head, &c.
Base, 24 by 16.5 inches, (elliptical.)
(Plate II.)

Tests.

1.—TANGENTIAL RESISTANCE.

Dimensions of cylinders:
Height, 5 inches.
Exterior diameter, 3 inches.
Interior diameter, 1 inch.
(Plate 4, Fig. 5.)
Original length of surface pressed, 4½ inches.

Specimen marked—	Actual bursting force.	Bursting force per square inch.	Remarks.
	Pounds.	*Pounds.*	
No. 1	46,400	59,078	Burst into three equal longitudinal pieces.
No. 2	52,850	67,290	Burst into three longitudinal pieces, with a transverse crack running three-fourths around at the point of maximum pressure.

These cylinders—taken from the specimens marked "tangential resistance"—were open at both ends, and were burst by means of a steel piston acting upon a composition of 4 parts of beeswax to 1 of tallow. A leather washer was inserted at each end.

2.—TRANSVERSE RESISTANCE.

Dimensions of bars:
Length, 22.5 inches.
Width, 1.075 inches.
Depth, 1.075 inches.
(Plate III, Fig. 3.)
Distance between points of support, 20 inches.

Specimen marked—	Breaking-weight.	Transverse resistance. $\frac{L.\ W.}{4\ bd.^2}$
Trans. I	2,750 pounds.	11,038 pounds.
Trans. O	3,000 "	12,074 "

3.—TENACITY, DENSITY, AND HARDNESS.

(Plate IV, fig. 4.)

Specimen marked—	Density.	Original area of cross-section.	Breaking-weight.	Tenacity per square inch.	Hardness.
		Inches.	*Pounds.*	*Pounds.*	
Tan. 1	7.3027	1.0064	33,000	32,789	18.00
Tan. 2	7.2027	1.0011	35,000	34,962	18.92

4.—ULTIMATE RESISTANCE TO CRUSHING FORCE.

Dimensions of cylinders:
Height, 2 inches.
Diameter, 0.8 inch.
(Plate IV, Fig. 6.)

Cylinders marked—	Actual crushing force.	Absolute resistance per square inch.	Remarks.
	Pounds.	*Pounds.*	
C. R. No. 1	52,500	104,445	Density of three cylinders tested together, 7.2681.
C. R. No. 2	62,250	123,842	
C. R. No. 3 *	52,900	105,241	
C. R. No. 3, dup	51,000	104.061	

* This specimen moved out of adjustment in the machine and was not completely crushed.

Cylinders C. R. No. 3 and C. R. No. 3, dup., were compressed about 0.29 inch, and became so badly bent that they could not be fully crushed, yet the metal seemed to have lost its cohesion completely.

It was afterward found that the straining-stirrups were not working in a straight line, which was the cause of the specimens being bent instead of crushed.

SPECIMEN EXT. O, 1.

I.—*Table showing the extension, restoration, and permanent set, per inch in length, caused by the undermentioned weights, per square inch of section, acting on a solid cylinder of cast iron 30 inches long and 1.377 inches diameter, cut longitudinally from exterior of trial-cylinder for 12-inch rifle.*

Weight per square inch of section.	Extension per inch in length.	Successive extension per inch in length.	Restoration per inch in length.	Successive restoration per inch in length.	Permanent set per inch in length.	Successive permanent set per inch in length.
Pounds.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1,000	.00005	.00000	.00005	.00000	.00000	.00000
2,000	.00009	.00004	.00009	.00004	.00000	.00000
3,000	.00015	.00006	.00015	.00006	.00000	.00000
4,000	.00019	.00004	.00019	.00004	.00000	.00000
5,000	.00026	.00007	.00026	.00007	.00000	.00000
6,000	.00027	.00001	.00024	—.00002	.00003	.00003
7,000	.00036	.00009	.00033	+.00009	.00003	.00000
8,000	.00038	.00002	.00037	.00004	.00001	—.00002
9,000	.00044	.00006	.00043	.00006	.00001	.00000
10,000	.00051	.00007	.00049	.00006	.00002	.00001
11,000	.00054	.00003	.00050	.00001	.00004	.00002
12,000	.00062	.00008	.00057	.00007	.00005	.00001
13,000	.00068	.00006	.00063	.00006	.00005	.00000
14,000	.00074	.00006	.00068	.00005	.00006	.00001
15,000	.00082	.00008	.00075	.00007	.00007	.00001
16,000	.00094	.00012	.00085	.00010	.00009	.00002
17,000	.00098	.00004	.00087	.00002	.00011	.00002
18,000	.00109	.00011	.00097	.00010	.00012	.00001
19,000	.00116	.00007	.00102	.00005	.00014	.00002
20,000	.00125	.00009	.00108	.00006	.00017	.00003
21,000	.00134	.00009	.00111	.00003	.00023	.00006
22,000	.00146	.00012	.00122	.00011	.00024	.00001
23,000	.00154	.00008	.00130	.00008	.00024	.00000
24,000	.00165	.00011	.00135	.00005	.00030	.00006
25,000	.00179	.00014	.00143	.00008	.00036	.00006
26,000	.00194	.00015	.00152	.00009	.00042	.00006
27,000	.00214	.00020	.00154	.00002	.00060	.00018
28,000	.00236	.00022	.00175	.00021	.00061	.00001
29,000	.00266	.00030	.00180	.00005	.00086	.00025
30,000	.00290	.00024	.00183	.00003	.00107	.00021
31,000	.00325	.00035	.00186	.00003	.00139	.00032

General summary.

Specific gravity	7.2984	Reduction in diameter at point of rupture.	0.002
Tensile strength per square inch, pounds	31,000	Original area of cross-section, sqr. inches.	1.4892
Elastic limit, pounds	6,000	Area after rupture, square inches	1.4849
Extension per inch at rupture	0″.00325	Position of rupture—lower shoulder.	
Hardness	18.00	Character of surface, bright and sharp.	
Extension under strain at elastic limit	0″.00027	Crystals, uniform size.	

SPECIMEN EXT. O, 2.

II.—*Table showing the extension, restoration, and permanent set, per inch in length, caused by the undermentioned weights, per square inch of section, acting on a solid cylinder of cast iron 30 inches long and 1.377 inches in diameter, cut longitudinally from outside of the trial-cylinder for 12-inch rifle.*

Weight per square inch of section.	Extension per inch in length.	Successive extension per inch in length.	Restoration per inch in length.	Successive restoration per inch in length.	Permanent set per inch in length.	Successive permanent set per inch in length.
Pounds.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1,000	.00005	.00000	.00005	.00000	.00000	.00000
2,000	.00014	.00009	.00014	.00009	.00000	.00000
3,000	.00019	.00005	.00019	.00005	.00000	.00000
4,000	.00024	.00005	.00024	.00005	.00000	.00000
5,000	.00028	.00004	.00028	.00004	.00000	.00000
6,000	.00031	.00003	.00031	.00003	.00000	.00000
7,000	.00036	.00005	.00036	.00005	.00000	.00000
8,000	.00043	.00007	.00043	.00007	.00000	.00000
9,000	.00050	.00007	.00050	.00007	.00000	.00000
10,000	.00053	.00003	.00053	.00003	.00000	.00000
11,000	.00058	.00005	.00057	.00004	.00001	.00001
12,000	.00063	.00005	.00061	.00004	.00002	.00001
13,000	.00071	.00008	.00069	.00008	.00002	.00000
14,000	.00077	.00006	.00074	.00005	.00003	.00001
15,000	.00082	.00005	.00079	.00005	.00003	.00000
16,000	.00090	.00008	.00085	.00006	.00005	.00002
17,000	.00095	.00005	.00090	.00005	.00005	.00000
18,000	.00101	.00006	.00095	.00005	.00006	.00001
19,000	.00111	.00010	.00102	.00007	.00009	.00003
20,000	.00119	.00008	.00108	.00006	.00011	.00002
21,000	.00128	.00009	.00115	.00007	.00013	.00002
22,000	.00138	.00010	.00120	.00005	.00018	.00005
23,000	.00149	.00011	.00128	.00008	.00021	.00003
24,000	.00161	.00012	.00134	.00006	.00027	.00006
25,000	.00178	.00017	.00142	.00008	.00036	.00009
26,000	.00191	.00013	.00149	.00007	.00042	.00006
27,000	.00210	.00019	.00158	.00009	.00052	.00010
28,000	.00230	.00020	.00166	.00008	.00064	.00012
29,000	.00258	.00028	.00174	.00008	.00084	.00020
30,000	.00283	.00025	.00180	.00006	.00103	.00019
31,000	.00318	.00035	.00192	.00012	.00126	.00023
32,000	Specimen broke.					

General summary.

Specific gravity	7.7259	Reduction in diameter at point of rupture	0″.001
Tensile strength per square inch, pounds	32,000	Original area of cross-section, sqr. inches	1.4892
Elastic limit, pounds	12,000	Area after rupture, square inches	1.4870
Extension per inch at rupture	0″.00318	Position of rupture—5 inches from lower shoulder.	
Hardness	18.00	Character of surface, bright, sharp, and small crystals of uniform size.	
Extension under strain at elastic limit	0″.00063		

SPECIMEN, EXT. I.

III.—*Table showing the extension, restoration, and permanent set, per inch in length, caused by the undermentioned weights, per square inch of section, acting on a solid cylinder of cast iron 20 inches long and 1.385 inches in diameter, cut longitudinally from center of trial-cylinder for 12-inch rifle.*

Weight per square inch of section.	Extension per inch in length.	Successive extension per inch in length.	Restoration per inch in length.	Successive restoration per inch in length.	Permanent set per inch in length.	Successive permanent set per inch in length.
Pounds.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1,000	.000045	.000000	.000045	.000000	.000000	.000000
2,000	.000060	.000015	.000060	.000015	.000000	.000000
3,000	.000110	.000050	.000110	.000050	.000000	.000000
4,000	.000205	.000095	.000205	.000095	.000000	.000000
5,000	.000275	.000070	.000275	.000070	.000000	.000000
6,000	.000305	.000030	.000305	.000030	.000000	.000000
7,000	.000385	.000080	.000385	.000080	.000000	.000000
8,000	.000435	.000050	.000435	.000050	.000000	.000000
9,000	.000510	.000075	.000510	.000075	.000000	.000000
10,000	.000570	.000060	.000560	.000050	.000010	.000010
11,000	.000635	.000065	.000615	.000055	.000020	.000010
12,000	.000660	.000025	.000625	.000010	.000035	.000015
13,000	.000760	.000100	.000715	.000090	.000045	.000010
14,000	.000860	.000100	.000800	.000085	.000060	.000015
15,000	.000930	.000070	.000845	.000045	.000085	.000025
16,000	.001135	.000205	.001000	.000155	.000135	.000050
17,000	.001160	.000025	.001015	.000015	.000145	.000010
18,000	.001210	.000050	.001050	.000035	.000160	.000015
19,000	.001320	.000110	.001130	.000080	.000190	.000030
20,000	.001410	.000090	.001160	.000030	.000250	.000060
21,000	.001585	.000175	.001325	.000165	.000260	.000010
22,000	.001985	.000400	.001585	.000260	.000400	.000140
23,000	.002060	.000075	.001525	—.000060	.000475	.000075
24,000	.002210	.000150	.001525	.000000	.000685	.000210
25,000	.002485	.000275	.001650	.000125	.000835	.000150
26,000	.003060	.000575	.001850	.000200	.002210	.001375
27,000	Specimen broke.					

General summary.

Specific gravity	7.2934	Reduction in diameter at point of rupture	0″.002
Tensile strength, per square inch, lbs.	27,000	Original area of cross-section, sqr. inches	1.5065
Elastic limit, pounds	10,000	Area after rupture, square inches	1.5022
Extension per inch at rupture	0″.00306	Position of rupture—near lower shoulder.	
Hardness	18.00	Character of surface, bright, sharp crystals of uniform size.	
Extension per inch at elastic limit	0″.000570		

REMARKS.—Owing to the existence of spongy metal at the center of the cylinder, a specimen of 20 inches length only could be obtained. The low tenacity of this specimen and the position of the rupture indicate that the specimen was not entirely of hard metal.

SPECIMEN EXT. I, DUP.

IV.—*Table showing the extension, restoration, and permanent set, per inch in length, caused by the undermentioned weights, per square inch of section, acting on a solid cylinder of cast iron 30 inches long and 1.386 inches in diameter, cut longitudinally from near the center of trial-cylinder for 12-inch rifle.*

Weight per square inch of section.	Extension per inch in length.	Successive extension per inch in length.	Restoration per inch in length.	Successive restoration per inch in length.	Permanent set per inch in length.	Successive permanent set per inch in length.
Pounds.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1,000	.00006	.00000	.00006	.00000	.00000	.00000
2,000	.00013	.00007	.00013	.00007	.00000	.00000
3,000	.00018	.00005	.00018	.00005	.00000	.00000
4,000	.00023	.00005	.00023	.00005	.00000	.00000
5,000	.00028	.00005	.00028	.00005	.00000	.00000
6,000	.00033	.00005	.00033	.00005	.00000	.00000
7,000	.00038	.00005	.00038	.00005	.00000	.00000
8,000	.00043	.00005	.00043	.00005	.00000	.00000
9,000	.00049	.00006	.00049	.00006	.00000	.00000
10,000	.00054	.00005	.00053	.00004	.00001	.00001
11,000	.00061	.00007	.00059	.00006	.00002	.00001
12,000	.00065	.00004	.00063	.00004	.00002	.00000
13,000	.00071	.00006	.00069	.00006	.00002	.00000
14,000	.00077	.00006	.00074	.00005	.00003	.00001
15,000	.00085	.00008	.00082	.00008	.00003	.00000
16,000	.00093	.00008	.00086	.00004	.00007	.00004
17,000	.00098	.00005	.00091	.00005	.00007	.00000
18,000	.00106	.00008	.00098	.00007	.00008	.00001
19,000	.00117	.00011	.00107	.00009	.00010	.00002
20,000	.00126	.00009	.00113	.00006	.00013	.00003
21,000	.00135	.00009	.00120	.00007	.00015	.00002
22,000	.00145	.00010	.00127	.00007	.00018	.00003
23,000	.00156	.00011	.00134	.00007	.00022	.00004
24,000	.00164	.00008	.00138	.00004	.00026	.00004
25,000	.00178	.00014	.00146	.00008	.00032	.00006
26,000	.00195	.00017	.00155	.00009	.00040	.00008
27,000	.00213	.00018	.00163	.00008	.00050	.00010
28,000	.00226	.00013	.00169	.00006	.00057	.00007
29,000	.00245	.00019	.00176	.00007	.00069	.00012
30,000	.00271	.00026	.00186	.00010	.00085	.00016
31,000	.00298	.00027	.00193	.00007	.00105	.00020
32,000	.00331	.00033	.00196	.00003	.00135	.00030
33,000	.00386	.00055	.00240	.00044	.00146	.00011
34,000	.00401	.00015	.00233	—.00007	.00168	.00022

General summary.

Specific gravity	7.2934	Reduction in diameter at point of rupture	0″.001
Tensile strength, per square inch, lbs.	34,000	Original area of cross section, sqr. inches	1.5067
Elastic limit, pounds	10,000	Area after rupture, square inches	1.5065
Extension per inch at rupture	0″.004	Position of rupture—At lower shoulder.	
Hardness	18.00	Character of surface, bright, small, and sharp, crystals of uniform size.	
Extension under strain at elastic limit.	0″.00054		

SPECIMEN COM. T.

V.—*Table showing the compression, restoration, and permanent set, per inch in length, caused by the undermentioned weights per square inch of section, acting on a solid cylinder of cast iron 9½ inches long and 1.385 inches in diameter, cut transversely from trial-cylinder for 12-inch rifle.*

Weight per square inch of section.	Compression per inch in length.	Successive compression per inch in length.	Restoration per inch in length.	Successive restoration per inch in length.	Permanent set per inch in length.	Successive permanent set per inch in length.
Pounds.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1,000	.00012	.00000	.00012	.00000	.00000	.00000
2,000	.00033	.00021	.00033	.00021	.00000	.00000
3,000	.00049	.00016	.00049	.00016	.00000	.00000
4,000	.00062	.00013	.00062	.00013	.00000	.00000
5,000	.00078	.00016	.00078	.00016	.00000	.00000
6,000	.00086	.00008	.00086	.00008	.00000	.00000
7,000	.00100	.00014	.00098	.00012	.00002	.00002
8,000	.00104	.00004	.00102	.00004	.00002	.00000
9,000	.00125	.00021	.00123	.00021	.00002	.00000
10,000	.00134	.00009	.00129	.00006	.00005	.00003
11,000	.00147	.00013	.00140	.00011	.00007	.00002
12,000	.00164	.00017	.00152	.00012	.00012	.00005
13,000	.00169	.00005	.00158	.00006	.00011	—.00001
14,000	.00183	.00014	.00169	.00011	.00014	+.00003
15,000	.00195	.00012	.00178	.00009	.00017	.00003
16,000	.00208	.00013	.00191	.00013	.00017	.00000
17,000	.00219	.00011	.00200	.00009	.00019	.00002
18,000	.00227	.00008	.00206	.00006	.00021	.00002
19,000	.00233	.00006	.00219	.00013	.00024	.00003
20,000	.00255	.00022	.00229	.00010	.00026	.00002
21,000	.00265	.00010	.00238	.00009	.00027	.00001
22,000	.00277	.00012	.00246	.00008	.00031	.00004
23,000	.00285	.00008	.00253	.00007	.00032	.00001
24,000	.00293	.00008	.00258	.00005	.00035	.00003
25,000	.00309	.00016	.00271	.00013	.00038	.00003
26,000	.00323	.00014	.00281	.00010	.00042	.00004
27,000	.00332	.00009	.00285	.00004	.00047	.00005
28,000	.00339	.00007	.00289	.00004	.00050	.00003
29,000	.00351	.00012	.00296	.00007	.00055	.00005
30,000	.00367	.00016	.00312	.00016	.00055	.00000
31,000	.00379	.00012	.00312	.00000	.00067	.00012
32,000	.00395	.00016	.00326	.00014	.00069	.00002
33,000	.00403	.00008	.00326	.00000	.00077	.00008
34,000	.00412	.00009	.00327	.00001	.00085	.00008
35,000	.00433	.00021	.00341	.00014	.00092	.00007
36,000	.00444	.00011	.00346	.00005	.00098	.00006
37,000	.00474	.00030	.00363	.00017	.00111	.00013
38,000	.00484	.00010	.00363	.00000	.00121	.00010
39,000	.00511	.00027	.00372	.00009	.00139	.00018
40,000	.00519	.00008	.00364	—.00008	.00155	.00016
41,000	.00538	.00019	.00362	—.00002	.00176	.00021
42,000	.00574	.00036	.00374	+.00012	.00200	.00024
43,000	.00621	.00047	.00394	.00020	.00227	.00027
						0027

General summary.

Elastic limit, pounds	6,800	Increase in diameter after 43,000 pounds per square inch	0″.0025
Compression per inch at 43,000 pounds	0″.00021	Original area of cross-section, square inches	1.5338
Compression under strain at elastic limit	0″.000931	Area after 43,000 pounds, square inches	1.5065

SPECIMEN COM. T, DUP.

VI.—*Table showing the compression, restoration, and permanent set, per inch in length, caused by the undermentioned weights, per square inch of section, acting on a solid cylinder of cast iron 10 inches long and 1.385 inches diameter, cut transversely from trial-cylinder for 12-inch rifle.*

Weight per square inch of section.	Compression per inch in length.	Successive compression per inch in length.	Restoration per inch in length.	Successive restoration per inch in length.	Permanent set per inch in length.	Successive permanent set per inch in length.
Pounds.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1,000	.00010	.00000	.00010	.00000	.00000	.00000
2,000	.00038	.00028	.00038	.00028	.00000	.00000
3,000	.00046	.00008	.00046	.00008	.00000	.00000
4,000	.00055	.00009	.00055	.00009	.00000	.00000
5,000	.00063	.00008	.00063	.00008	.00000	.00000
6,000	.00071	.00008	.00071	.00008	.00000	.00000
7,000	.00076	.00005	.00076	.00005	.00000	.00000
8,000	.00084	.00008	.00084	.00008	.00000	.00000
9,000	.00090	.00006	.00090	.00006	.00000	.00000
10,000	.00094	.00004	.00094	.00004	.00000	.00000
11,000	.00100	.00006	.00100	.00006	.00000	.00000
12,000	.00106	.00006	.00104	.00004	.00002	.00002
13,000	.00113	.00007	.00107	.00003	.00006	.00004
14,000	.00120	.00007	.00113	.00006	.00007	.00001
15,000	.00126	.00006	.00118	.00005	.00008	.00001
16,000	.00136	.00010	.00127	.00009	.00009	.00001
17,000	.00151	.00015	.00141	.00014	.00010	.00001
18,000	.00173	.00002	.00140	−.00001	.00013	.00003
19,000	.00156	.00003	.00140	.00000	.00016	.00003
20,000	.00163	.00007	.00145	.00005	.00018	.00002
21,000	.00173	.00010	.00154	.00009	.00019	.00001
22,000	.00182	.00009	.00161	.00007	.00021	.00002
23,000	.00194	.00012	.00166	.00005	.00028	.00007
24,000	.00201	.00007	.00168	.00002	.00033	.00005
25,000	.00209	.00008	.00174	.00006	.00035	.00002
26,000	.00222	.00013	.00185	.00011	.00037	.00002
27,000	.00232	.00010	.00193	.00008	.00039	.00002
28,000	.00242	.00010	.00201	.00008	.00041	.00002
29,000	.00254	.00012	.00204	.00003	.00050	.00009
30,000	.00269	.00015	.00214	.00010	.00055	.00005
31,000	.00288	.00019	.00216	.00002	.00072	.00017
32,000	.00323	.00035	.00234	.00018	.00089	.00017
33,000	.00326	.00003	.00227	−.00007	.00099	.00010
34,000	.00354	.00028	.00241	+.00014	.00113	.00014
35,000	.00373	.00019	.00239	−.00002	.00134	.00021
36,000	.00426	.00053	.00259	+.00020	.00167	.00033
37,000	.00446	.00020	.00267	.00008	.00179	.00012
38,000	.00476	.00030	.00255	−.00012	.00221	.00042
39,000	.00524	.00048	.00280	+.00025	.00244	.00023
40,000	.00579	.00055	.00288	.00008	.00291	.00047
41,000	.00624	.00045	.00293	.00005	.00331	.00040
42,000	.00729	.00105	.00318	.00025	.00411	.00080
43,000	.00789	.00060	.00310	−.00008	.00479	.00068

General summary.

Elastic limit, pounds	12,000	Increase in diameter after 43,000 pounds per square inch	0″.003
Compression per inch at 43,000 pounds	0″.00789	Original area of cross-section	1″.5065
Compression under strain at elastic limit	0″.00106	Area after 43,000 pounds	1″.5131

SPECIMEN COM. O.

VII.—*Table showing the compression, restoration, and permanent set, per inch in length, caused by the undermentioned weights, per square inch of section, acting on a solid cylinder of cast iron 10 inches long and 1.385 inches diameter, cut from near the exterior of trial-cylinder for 12-inch rifle.*

Weight per square inch of section.	Compression per inch in length.	Successive compression per inch in length.	Restoration per inch in length.	Successive restoration per inch in length.	Permanent set per inch in length.	Successive permanent set per inch in length.
Pounds.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1,000	.00011	.00000	.00011	.00000	.00000	.00000
2,000	.00037	.00026	.00037	.00026	.00000	.00000
3,000	.00053	.00016	.00053	.00016	.00000	.00000
4,000	.00068	.00015	.00068	.00015	.00000	.00000
5,000	.00085	.00017	.00085	.00017	.00000	.00000
6,000	.00097	.00012	.00090	.00005	.00007	.00007
7,000	.00109	.00012	.00095	.00005	.00014	.00007
8,000	.00120	.00011	.00105	.00010	.00015	.00001
9,000	.00130	.00010	.00114	.00009	.00016	.00001
10,000	.00139	.00009	.00122	.00008	.00017	.00001
11,000	.00150	.00011	.00132	.00010	.00018	.00001
12,000	.00158	.00008	.00140	.00008	.00018	.00000
13,000	.00168	.00010	.00149	.00009	.00019	.00001
14,000	.00177	.00009	.00161	.00012	.00016	—.00003
15,000	.00185	.00008	.00164	.00003	.00021	.00005
16,000	.00198	.00013	.00174	.00010	.00024	.00003
17,000	.00207	.00009	.00185	.00011	.00022	—.00002
18,000	.00220	.00013	.00196	.00011	.00024	.00002
19,000	.00231	.00011	.00206	.00010	.00025	.00001
20,000	.00241	.00010	.00215	.00009	.00026	.00001
21,000	.00260	.00019	.00233	.00018	.00027	.00001
22,000	.00262	.00002	.00234	.00001	.00028	.00001
23,000	.00270	.00008	.00241	.00007	.00029	.00001
24,000	.00282	.00012	.00252	.00011	.00030	.00001
25,000	.00292	.00010	.002595	.000075	.000325	.000025
26,000	.00301	.00009	.002672	.000077	.000338	.000013
27,000	.00307	.00006	.00272	.000048	.00035	.000012
28,000	.00326	.00019	.00289	.00017	.00037	.00002
29,000	.003335	.000075	.002935	.000045	.00040	.00003
30,000	.00344	.000105	.00301	.000075	.00043	.00003
31,000	.00350	.00006	.00307	.00006	.00043	.00000
32,000	.00355	.00005	.00310	.00003	.00045	.00002
33,000	.00366	.00011	.00317	.00007	.00049	.00004
34,000	.00378	.00012	.00324	.00007	.00054	.00005
35,000	.00392	.00014	.00332	.00008	.00060	.00006
36,000	.00409	.00017	.00347	.00015	.00062	.00002
37,000	.00424	.00015	.00347	.00000	.00077	.00015
38,000	.00435	.00011	.00345	—.00002	.00090	.00013
39,000	.00451	.00016	.00355	.00010	.00096	.00006
40,000	.00463	.00012	.00355	.00000	.00108	.00012
41,000	.00493	.00030	.00377	.00012	.00116	.00008
42,000	.00510	.00017	.00384	.00007	.00126	.00010
43,000	.00531	.00021	.00389	.00005	.00142	.00016

General summary.

Elastic limit, pounds	5,200	Increase in diameter after 43,000 pounds per square inch	0″.002
Compression per inch at 43,000 pounds	0″.00531	Original area of cross-section, square inches	1.5368
Compression under strain at elastic limit	0″.00088	Area after 43,000 pounds, square inches	1.5109

SPECIMEN COM. O, DUP.

VIII.—*Table showing the compression, restoration, and permanent set, per inch in length caused by the undermentioned weights, per square inch of section, acting on a solid cylinder of cast iron 10 inches long and 1.383 inches diameter, cut transversely from trial-cylinder for 12-inch rifle.*

Weight per square inch of section.	Compression per inch in length.	Successive compression per inch in length.	Restoration per inch in length.	Successive restoration per inch in length.	Permanent set per inch in length.	Successive permanent set per inch in length.
Pounds.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1,000	.00007	.00000	.00007	.00000	.00000	.00000
2,000	.00025	.00018	.00025	.00018	.00000	.00000
3,000	.00038	.00013	.00038	.00013	.00000	.00000
4,000	.00047	.00009	.00047	.00009	.00000	.00000
5,000	.00055	.00008	.00055	.00008	.00000	.00000
6,000	.00064	.00009	.00064	.00009	.00000	.00000
7,000	.00072	.00008	.00072	.00008	.00000	.00000
8,000	.00078	.00006	.00078	.00006	.00000	.00000
9,000	.00086	.00008	.00085	.00007	.00001	.00001
10,000	.00091	.00005	.00090	.00005	.00001	.00000
11,000	.00101	.00010	.00098	.00008	.00003	.00002
12,000	.00107	.00006	.00102	.00004	.00005	.00002
13,000	.00114	.00007	.00108	.00006	.00006	.00001
14,000	.00121	.00007	.00112	.00004	.00009	.00003
15,000	.00129	.00008	.00118	.00006	.00011	.00002
16,000	.00136	.00007	.00122	.00004	.00014	.00003
17,000	.00153	.00017	.00138	.00016	.00015	.00001
18,000	.00159	.00006	.00143	.00005	.00016	.00001
19,000	.00161	.00002	.00142	—.00001	.00019	.00003
20,000	.00173	.00012	.00151	.00009	.00022	.00003
21,000	.00178	.00005	.00155	.00004	.00023	.00001
22,000	.00195	.00017	.00169	.00014	.00026	.00003
23,000	.00197	.00002	.00169	.00000	.00028	.00002
24,000	.00208	.00011	.00177	.00008	.00031	.00003
25,000	.00211	.00003	.00175	—.00002	.00036	.00005
26,000	.00218	.00007	.00180	+.00005	.00038	.00002
27,000	.00222	.00004	.00182	.00002	.00040	.00002
28,000	.00231	.00009	.00185	.00003	.00046	.00006
29,000	.00238	.00007	.00187	.00002	.00051	.00005
30,000	.00251	.00013	.00197	.00010	.00054	.00003
31,000	.00273	.00022	.00215	.00018	.00058	.00004
32,000	.00278	.00005	.00210	—.00005	.00068	.00010
33,000	.00284	.00006	.00210	.00000	.00074	.00006
34,000	.00296	.00012	.00215	+.00005	.00081	.00007
35,000	.00307	.00011	.00211	—.00004	.00096	.00015
36,000	.00338	.00031	.00224	+.00013	.00114	.00018
37,000	.00360	.00022	.00244	.00020	.00116	.00002
38,000	.00376	.00016	.00248	.00004	.00128	.00012
39,000	.00396	.00020	.00254	.00006	.00142	.00014
40,000	.00446	.00050	.00267	.00013	.00179	.00037
41,000	.00471	.00025	.00280	.00013	.00191	.00012
42,000	.00491	.00020	.00280	.00000	.00210	.00019
43,000	.00536	.00045	.00282	.00002	.00254	.00044

General summary.

Elastic limit, pounds	9,000	Increase in diameter after 43,000 pounds per square inch	0″.003
Compression per inch at 43,000 pounds	0″.00536	Original area of cross-section, square inches	1.5022
Compression under strain at elastic limit	0″.00086	Area after 43,000 pounds, square inches	1.5065

MEAN PHYSICAL PROPERTIES OF TRIAL-CYLINDER, AS DETERMINED FROM FOREGOING RESULTS.

Density	7.2771	
Tenacity	33,875	pounds.
Elastic limit under tensile strain	9,750	"
Extension under strain at elastic limit	0.00051	inch.
Ultimate extension per inch	0.00337	"
Ultimate restoration from extension	0.00199	"
Permanent set	0.00163	"

Elastic limit under strain of compression	8,200	pounds.
Compression per inch under strain of elastic limit	0.00093	inch.
Compression per inch at 35,000 pounds	0.00376	"
Restoration from compression at 35,000 pounds	0.00280	"
Permanent set from compression at 35,000 pounds	0.000955	"
Transverse resistance	11,556	pounds.
Tangential resistance per square inch	63,184	"
Ultimate resistance to crushing force	114,143	"
Hardness	18.00	
Hardness of copper	4.16	

Mechanical tests of bar-iron (English Ridsdale) employed in fabrication of coiled wrought-iron tube for 12-inch rifle.

SPECIMEN NO. 1.—ENGLISH (RIDSDALE) BAR-IRON.

Table showing the extension, restoration, and permanent set, caused by the undermentioned weights, per square inch of section, acting gradually upon a solid cylinder of wrought iron 2.007 inches long and 0.568 inch diameter, taken along the fiber, from a sample of bar-iron furnished by Sir William Armstrong, and employed in the manufacture of the coiled wrought-iron tube for the 12-inch rifle.

Weight per square inch of section.	Extension per inch in length.	Successive extension per inch in length.	Restoration per inch in length.	Successive restoration per inch in length.	Permanent set per inch in length.	Successive permanent set per inch in length.
Pounds.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1,973.2	0.0009965	0.0009965	0.0009965	0.0009965	0.0000000	0.0000000
3,946.5	0.0014948	0.0004983	0.0014948	0.0004983	0.0000000	0.0000000
4,933.1	0.0014948	0.0000000	0.0014948	0.0000000	0.0000000	0.0000000
5,919.7	0.0014948	0.0000000	0.0014948	0.0000000	0.0000000	0.0000000
7,893.0	0.0019976	0.0005028	0.0019976	0.0005028	0.0000000	0.0000000
9,866.3	0.0019976	0.0000000	0.0019976	0.0000000	0.0000000	0.0000000
11,839.9	0.0019976	0.0000000	0.0019976	0.0000000	0.0000000	0.0000000
13,812.7	0.0024913	0.0004937	0.0024913	0.0004937	0.0000000	0.0000000
15,786	0.0024913	0.0000000	0.0024913	0.0000000	0.0000000	0.0000000
17,759.2	0.0024913	0.0000000	0.0024913	0.0000000	0.0000000	0.0000000
19,732.5	0.0034878	0.0009965	0.0024913	0.0000000	0.0009965	0.0009965
21,705.8	0.0039860	0.0004982	0.0024913	0.0000000	0.0014947	0.0004982
23,679	0.0044842	0.0004982	0.0029895	0.0004982	0.0014947	0.0000000
35,518.5	0.0209270	0.0164428	0.0024913	—0.0004982	0.0184357	0.0169410
37,492	0.0269050	0.0059780	0.0014948	—0.0009965	0.0254102	0.0069745
43,411.9	0.0577980	0.0308930	0.0024913	0.0009965	0.0553067	0.0298965
45,424.2	0.0632770	0.0054790	0.0019976	—0.0004937	0.0612794	0.0059727
47,358	0.0931700	0.0298930	0.0049826	0.0029850	0.0881874	0.0269080
49,331.2	0.1051300	0.0119600	0.0029895	—0.0019931	0.1021405	0.0139531
51,304.5	0.1778800	0.0727500	0.0039861	0.0009966	0.1738939	0.0717534
52,291.2	0.2082800	0.0304000	0.0009965	—0.0029896	0.2072835	0.0333896
53,277.8	9.2964600	0.0881800	Specimen broke.			

General summary.

Specific gravity	7.6441	Reduction in diameter at point of rupture	0".122
Tensile strength per sq. inch, pounds	53,277.8	Original area of cross-section, square inches	0.2534
Elastic limit, pounds	18,000	Area after rupture, square inches	0.1559
Extension per inch at rupture	0".296	Position of rupture—Near middle.	
Hardness	9.717	Character of rupture, crystals in spots.	
Elongation per inch at elastic limit	.003		

SPECIMEN NO. 4, ENGLISH (RIDSDALE) BAR-IRON.

Table showing the extension, restoration, and permanent set, caused by the undermentioned weights, per square inch of section, acting gradually upon a solid cylinder of wrought iron 2.007 inches long and 0.55 inch diameter, taken along the fiber from a sample of bar-iron furnished by Sir William Armstrong and employed in the manufacture of the coiled wrought-iron tube for the 12-inch rifle.

Weight per square inch of section.	Extension per inch in length.	Successive extension per inch in length.	Restoration per inch in length.	Successive restoration per inch in length.	Permanent set per inch in length.	Successive permanent set per inch in length.
Pounds.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
2,104.5	0.0005	0.0005	0.0005	0.0005	0.0000	0.0000
4,209.1	0.0005	0.0000	0.0005	0.0000	0.0000	0.0000
6,313.3	0.0005	0.0000	0.0005	0.0000	0.0000	0.0000
8,418.1	0.0010	0.0005	0.0010	0.0005	0.0000	0.0000
10,522.6	0.0015	0.0005	0.0015	0.0005	0.0000	0.0000
12,627.2	0.0015	0.0000	0.0015	0.0000	0.0000	0.0000
14,731.7	0.0020	0.0005	0.0020	0.0005	0.0000	0.0000
16,836.2	0.0020	0.0000	0.0020	0.0000	0.0000	0.0000
18,940.7	0.0020	0.0000	0.0020	0.0000	0.0000	0.0000
21,045.6	0.0020	0.0000	0.0020	0.0000	0.0000	0.0000
23,149.8	0.0025	0.0005	0.0025	0.0005	0.0000	0.0000
25,254.3	0.0025	0.0000	0.0020	−0.0005	0.0005	0.0005
27,358.8	0.0030	0.0005	0.0020	0.0000	0.0010	0.0005
29,463.3	0.0040	0.0010	0.0020	0.0000	0.0020	0.0010
31,567.8	0.0045	0.0005	0.0025	0.0005	0.0020	0.0000
33,672.4	0.0056	0.0011	0.0015	−0.0010	0.0041	0.0021
35,776.9	0.0090	0.0034	0.0010	−0.0005	0.0080	0.0039
37,881.4	0.0164	0.0074	0.0025	0.0015	0.0139	0.0059
39,987	0.0178	0.0014	0.0020	−0.0005	0.0158	0.0019
42,090.5	0.0339	0.0161	0.0010	−0.0010	0.0329	0.0171
44,195	0.0429	0.0090	0.0025	0.0015	0.0404	0.0075
47,378	0.0503	0.0074	0.0025	0.0000	0.0478	0.0074
48,446.1	0.0557	0.0054	0.0020	−0.0005	0.0537	0.0059
50,508.6	0.0724	0.0167	0.0020	0.0000	0.0704	0.0167
52,613.1	0.1241	0.0517	0.0020	0.0000	0.1221	0.0517
54,191.5	0.2008	0.0767	0.0040	0.0020	0.1968	0.0747
54,296.7	0.2416	0.0408	Specimen broke.			

General summary.

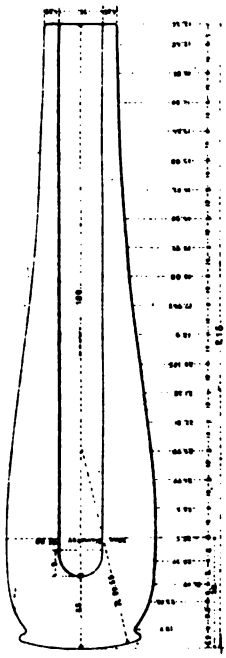
Specific gravity	7.6392	Reduction in diameter at point of rupture	0″.082
Tensile strength per square inch, pounds	54,296.7	Original area of cross-section, square inches	0.2376
Elastic limit, pounds	23,500	Area after rupture, square inches	0.1720
Extension per inch at rupture	0″.2416	Position of rupture—Near middle.	
Hardness	9.717	Character of rupture, fibrous and slightly crystalline.	
Elongation per inch at elastic limit	0″.0026		

Mean physical properties of English (Ridsdale) bar-iron employed in manufacture of coiled wrought-iron tube for 12-inch rifle.

Density	7.6353	
Tenacity—along the fiber	56,800	pounds.
across the fiber and parallel with the depth of the bar	42,000	"
across the fiber and perpendicular to the depth of the bar	24,000	"
Elastic limit under strain of extension	21,333	"
Extension per inch at elastic limit	0.0029	inch.
Ultimate extension, per inch	0.264	"
Ultimate restoration, per inch	0.0025	"
Ultimate permanent set, per inch	0.2030	"
Hardness	9.717	
Hardness of copper	4.16	

MODEL of PROPOSED
XII INCH EXPERIMENTAL CAST IRON RIFLE
RECOMMENDED BY BOARD OF ARMAMENT &c.

MODEL of PROPOSED
XV INCH, S.B. EXPERIMENTAL CAST IRON GUN
RECOMMENDED BY BOARD OF ARMAMENT &c.



The provisions of the above-named sections have been taken from the act of April 23, 1808, ch. 55; the act of March 3, 1855, ch. 169; and the act of March 3, 1873, ch. 282.

By the first of those sections (sec. 1661) an annual appropriation is made "for the purpose of providing arms and equipments for the whole body of the militia." The next section (sec. 1667) provides for an annual distribution among the several States and Territories of the arms procured by means of such appropriation. It requires these arms to be transmitted by the United States to the several States and Territories, the quota for each State to be according to the number of its Representatives and Senators, and the quota for each Territory, including the District of Columbia, to be according as the President may prescribe. The remaining section (sec. 1670) is only applicable to the particular case where a State did not receive its proper quota of arms and military equipments for any period from 1862 to 1869. It authorizes the Secretary of War, in that case, to distribute to such State its quota for that period, subject to the proviso therein contained.

In none of these sections adverted to is there any provision which expressly vests the property in the arms, after their distribution, in the States absolutely; nor do I find anything therein from which such a change of ownership results by necessary implication. To get at the intent and meaning of the existing laws, with reference to that point, it seems therefore proper to recur to the earlier legislation on the subject of arming the militia, and particularly to that part of it from which the provisions in the Revised Statutes have been taken.

The power of Congress to legislate on that subject is expressly conferred by the Constitution, (see article 1, sec. 8, par. 16;) and the first instance of the exercise of this power by that body is found in the act of May 8, 1792, entitled "An act more effectually to provide for the national defense, by establishing an uniform militia throughout the United States." (1 Stat., 271.) There it consisted simply in requiring each enrolled militiaman to "provide himself" with arms of a certain description. (See 1st section of that act.) This requirement is, however, reproduced in the Revised Statutes, (see section 1628,) and it constitutes now, as it did originally, what may be regarded the general law upon the subject of arming the militia, the other provisions of the Revised Statutes upon the same subject, to which reference has been made, being auxiliary, and not substitutive, in their character.

Next followed the act of July 6, 1798, entitled "An act providing arms for the militia throughout the United States." (1 Stat., 576.) By this act thirty thousand stand of arms were authorized to be provided, at the expense of the Government of the United States, and "sold to the governments of the respective States, or the militia thereof," under such regulations and at such prices as the President might prescribe. But its object was only to meet an immediate want then felt by some of the States, (especially the Southern,) the people whereof were generally destitute of arms, and could not easily supply themselves therewith. It sought to facilitate the procurement of arms by the latter to a limited extent, by enabling them or their respective States to purchase the same from the United States. The act of April 2, 1808, authorizing the sale of public arms to the States, (2 Stat., 481,) though it does not purport to have been passed with a view to arming the militia, is of a piece with the act of 1798, and contemplated similar objects.

The act of April 23, 1808, entitled "An act making provision for arming and equipping the whole body of the militia of the United States," (2 Stat., 490,) is the first statute that contains provisions of a

general and permanent nature for furnishing arms and equipments to the militia by the United States; and it deserves to be well considered here, for the reason that some of the more important of its provisions directed to that end are embodied in one or two of the sections of the Revised Statutes above quoted. The first section of the act is in substance the same as section 1661 of the Revised Statutes. It appropriates the sum of $200,000 annually "for the purpose of providing arms and military equipments for the whole body of the militia of the United States, either by purchase or manufacture by and on account of the United States." The third section declares that the arms procured in virtue of the act "shall be transmitted to the several States composing this Union and Territories thereof, to each State and Territory, respectively, in proportion to the number of the effective militia in each State and Territory, and by each State and Territory to be distributed to the militia in such State and Territory, under such rules and regulations as shall be by law prescribed by the legislature of each State and Territory." The rest of the act is not material in this connection.

The object of the annual appropriation made by this act is plainly expressed therein. It was to provide arms and equipments for the entire militia of the United States as far as such appropriation would enable this to be done. That object was contemplated to be carried out partly through the agency of officers of the General Government and partly through the intervention of the State authorities. Thus the procuring of the arms, with the means provided therefor, was, in the first place, to be done by officers of the United States, who were then to transmit the same to each State and Territory in proportion to the number of the effective militia thereof; whereupon the State and territorial authorities were to distribute the arms so transmitted to them among the militia in their respective States and Territories, under such rules and regulations as should be prescribed by the local laws. Accordingly, the States and Territories with which arms were deposited under this act must be deemed to have held them for a specific purpose only, and consequently (regarding the subject from a strictly legal point of view) to have had no right to divert them from that purpose by alienation or otherwise. They stood as it were in the situation of trustees charged with the distribution of the arms, and had no other property therein than such as was necessary to enable them to perform that trust.

That the States and Territories, in contemplation of this statute, were to be vested with a qualified, not an absolute, ownership of the arms transmitted to them, is very manifest from its terms, which exclude the idea that a power to dispose of the arms, in any manner and for any purpose, such as would be incident to absolute ownership alone, was intended, by which the very object of the law (viz, the arming of the militia) might be frustrated altogether. A similar view was taken by the Senate in 1855, by which it was then thought necessary, in order to enable the States and Territories to sell the arms theretofore distributed under the act of 1808, to make provision therefor by statute, as impliedly appears from the action of that body in passing, by way of amendment to the army appropriation bill then pending before it, a section which provided "that the governors of the several States and Territories be, and they are hereby, authorized to sell to the best advantage the arms heretofore distributed under the act of April 23, 1808, and invest the funds arising out of such sales in other arms more suitable for the purposes contemplated by said act: *Provided*, That no arms be so purchased or provided except such as may be of the same description and caliber as those regularly adopted and in use in the Army

of the United States." This amendment was not concurred in by the House, on the recommendation of the Committee of Ways and Means, and so it did not become a law. Yet, while the negative action of the House cannot with certainty be attributed to a difference of view as to the power of the States and Territories over such arms under the then existing laws, (for it may have proceeded from a doubt as to the expediency of the proposed measure,) the affirmative action of the Senate can assuredly be taken as an indication of its sense with respect to such power, and that was clearly this, that the power, whatever it might be, did not include the right to alienate the arms without the consent of Congress.

But to look at the subject from another stand-point. I have already adverted to the fact that the power of Congress to provide for the arming of the militia is expressly conferred by the Constitution. It is not maintained that this power is exclusively vested in Congress. It is merely an affirmative power, and if not in its own nature incompatible with the existence of a like power in the States, it may well leave a concurrent power in the latter; so that, if Congress did not choose to make any provision for arming the militia, it would be competent to the States to do it in such manner as they might think proper. But when once Congress has carried this power into effect, its laws for the arming of the militia are the supreme law of the land, and all interfering State regulations must necessarily be suspended in their operation. (Houston *vs.* Moore, 5 Wheat., 51.) Now it appears that in the exercise of this power, and with a view to provide for the national defense, Congress had undertaken to furnish arms for the militia at the expense of the General Government. The kind and pattern of arms to be thus furnished were left to the determination of the officers of the General Government, and hence such arms as were procured and transmitted by these officers to the States and Territories for the militia thereof must be regarded as arms specifically provided therefor by the paramount law. This being the case, is it not obvious that the State and territorial authorities could not rightfully exchange those arms for others of a different kind or pattern, and distribute the latter to the militia in place of the former; or sell the arms so provided and invest the proceeds of the sale in other property which such authorities might conceive to be more needful to promote the efficiency of the militia? In either of these cases the action of the State and territorial authorities would manifestly be in direct collision with the supreme law of the land.

Still it is to be observed that the statute under consideration made no provision for any accountability to the United States, in regard to the disposition of the arms, after their delivery to the State and territorial authorities. When that took place the control of the officers of the General Government over the arms ceased; and whether the future destination or use of the property was consistent with the design of the statute depended wholly upon the good faith of the States and Territories themselves. Practically, then, they might do what they pleased with it, though the disposition made of it by them should defeat the ends of the statute; for no way existed, as I conceive, to compel the execution of the trust devolved upon them.

By the seventh section of the act of March 3, 1855, (10 Stat., 639,) the annual distribution of arms to the States, which, under the act of 1808, was made in proportion to the number of the effective militia thereof, was required to be made according to the number of their Representatives and Senators in Congress, respectively; and, in regard

to the Territories and the District of Columbia, the arms were by the same section required to be distributed in such quantities and under such regulations as the President in his discretion might prescribe. These provisions are substantially embodied in section 1667 of the Revised Statutes. They modify the previous law no further than to introduce a new basis for making distribution of the arms to the States and Territories, which thenceforth took the place of the one originally prescribed.

Thus the law remained, touching the transmission of arms to the several States and Territories for the militia, up to the time of the adoption of the Revised Statutes; and I discover nothing in the provisions of the latter indicative of an intention on the part of Congress to clothe the States with any right of property in the arms thereafter to be transmitted to them, other or different from that which they had in the arms theretofore deposited with them. The purpose of the annual appropriation thereby provided is the same precisely as was that of the similar appropriation provided by the statute formerly in force, viz, to furnish arms for the militia. The basis upon which the arms are to be distributed to the States is likewise the same as that previously established, (*i. e.* by the act of 1855, cited above;) and they are required to be transmitted to the several States by the United States. It is true that in the Revised Statutes there is no clause expressly directing the arms to be distributed by each State to the militia thereof, as there was in the former statute; but the omission to insert any such clause therein is not to be understood as signifying an intent to relieve the States from that charge. The inference necessarily follows, from the declared purpose for which the appropriation for procuring the arms is made, that they are to be transmitted to the States for distribution among the militia, and for that object solely; and an express direction to that effect not being therefore really needed, it is probable that for this reason none was inserted.

Viewing the provisions of the Revised Statutes above quoted in connection with the previous legislation, I am unavoidably brought to the conclusion that, in contemplation of those provisions, the arms transmitted to the States thereunder are to be held by them for a specific purpose only, which is pointed out therein; that they therefore become, strictly speaking, invested with nothing more than a qualified property in such arms; and that they cannot, as a matter of right, and without thereby interfering with the regulations of Congress on a subject over which its authority is necessarily paramount, make any disposition or use of such arms which defeats the purpose referred to, though, if this should be done, there would seem to be no remedy without further legislation by Congress.

In answer, then, to the question propounded, I have the honor to state that, in my opinion, the States do not by the existing laws have "the right of property in the arms issued for arming the militia," if an absolute right of property is there meant; and that they derive no authority under those laws to sell or dispose of such arms at their pleasure. As I have already observed, the statute makes no provision for any accountability whatever to the General Government respecting the disposition of the arms when they have once been delivered to the States, Congress having seen fit to leave it entirely to the good faith of the latter, after the delivery takes place, to carry out the purpose contemplated in furnishing the arms.

In regard to the actual case here presented, which concerns a part of the quota of arms due the State of Virginia, I may add that the disposition of the revolvers hereinbefore mentioned recently sought to be

made by the authorities of that State would clearly have been unwarranted by the existing laws of Congress on the subject of arming the militia. It was accordingly very proper for the Chief of Ordnance to withhold the delivery of the revolvers to the parties to whom the orders issued therefor had been assigned. He could not, under those laws, recognize any right in such parties to the revolvers. But the arms cannot be indefinitely withheld from the State; the statute requiring them not only to be annually distributed, but to be transmitted to it by the General Government. After this is accomplished, the officers of the latter have nothing further to do with the arms so transmitted.

I am, sir, very respectfully, your obedient servant,

GEO. H. WILLIAMS,
Attorney-General.

Hon. W. W. BELKNAP,
Secretary of War.

APPENDIX W.

Artesian well at Benicia arsenal.

BENICIA ARSENAL,
Benicia, Cal., August 14, 1877.

To the CHIEF OF ORDNANCE,
Washington, D. C.:

SIR: I have the honor to submit for your consideration the fifth annual report of the work performed in boring an artesian well at this arsenal; it embraces all the operations which have transpired between July 1, 1876, and June 30, 1877, inclusively. The progress made in boring the well has been good, the only drawback encountered being the insufficiency of the appropriation. "Money is the sinew of war," and it is certainly the muscle of work; the want of it can put a straight-jacket on the best efforts and this deficiency which has been experienced more especially toward the end of our work, will certainly cost the Government something in the future.

If the 7-inch pipe could have been used until it became a fixture, a flowing well might have resulted with but a small expenditure. Unfortunately the use of this pipe had to be resigned before there was any necessity for relinquishing it, owing to the want of money to prosecute the undertaking.

As I have already stated, it is very hazardous to venture on any conjectures in reference to the success or disappointment to be encountered in such work. Our progress is through a "*terra incognita*," in entering on which we cannot avail ourselves of the knowledge of others, as none have penetrated to the same extent as ourselves into the virgin bosom of the Pacific soil. We must therefore earn our own experience and be content to serve as a guide to our imitators. Our experience, as far as we are concerned, is like the stern light of a ship, which illuminates the past track, but does not shed any particular radiance on the path in advance. Our work was pursued at first with the confidence of new miners, and with glowing anticipations of success, but the reverses and accidents encountered daily in the years '75 and '76, have toned down the concert pitch of enthusiasm to a systematic persevering and uphill pull.

This report can boast of one advantage over that of last year. It contains an account of decided progress toward the center of the earth, and that a third stream of water has been reached. This last is one of the few anticipations expressed in former reports that have proved correct. I submit below, in detail, the work accomplished each month, but cannot enumerate the accidents which have retarded it from time to time.

Last year's report left the well in the following condition: It was piped with an 11-inch pipe 200 feet, then with a 9-inch pipe 557 feet, and then an 8-inch pipe reached from surface of ground to a depth of 959 feet; below this last pipe the well being bored out to a diameter of $7\frac{3}{4}$ inches, for a depth of 134 feet 8 inches, making a total depth of 1,093 feet 8

inches. This lower portion of the well was not piped, but the 7-inch pipe was already made and prepared for lowering into the well, and we were only waiting to hear that an appropriation for this work had been made by Congress to continue it.

The 7-inch pipe had been placed in the well last year, but was withdrawn on account of breakage, and it was known that many pieces of iron were at the bottom of the well, which were the results of accidents already enumerated in my last report.

The work was resumed this year, as soon as it was ascertained that funds were available for this purpose, on the 25th day of July. The well was gauged to a distance of 1,030 feet with a cylinder gauge 7½ inches in diameter. This gauge passed freely down to this distance, which was 71 feet below the bottom of the 8-inch pipe. On lowering the pump, it was found that the well was filled by the *débris* from cavings to a depth of 63 feet 8 inches. It was attempted to clear this space out, but it filled in as soon as any of the loose sand was removed, and no progress could be made unless the pipe followed the drill and pump closely. The pipe was then lowered, and in the few remaining days of the month 433 feet were inserted in the well.

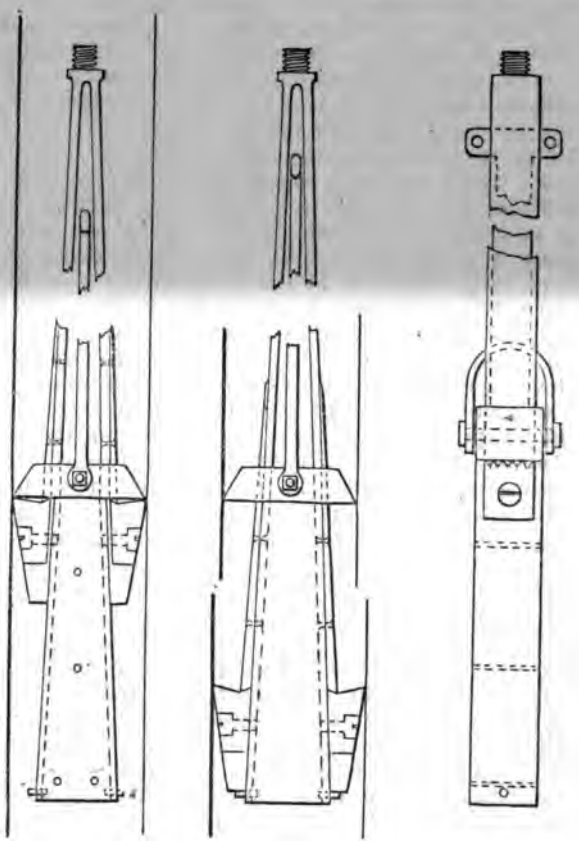
The first ten days of August were occupied in attaching new sections of pipe and lowering it, until the pipe rested on the *débris* at the bottom of well. The pump was then used, but could not remove any portion of this filling, which had become hard, and it was found necessary to use the drill, without the side cutter, however, to loosen it, so that it might enter the pump. All through this mass of sand and broken pieces of shale were found pieces of the old 7-inch pipe, and these, as they would not enter the valve of the pump, had to be removed by the kit extractor, as they were successively uncovered by the gradual removal of the conglomerate which covered them. One of the pieces consisted of a mass of sheet-iron hammered together by the former use of the drill, and weighing 15 pounds in the air. Six days were employed in this month in mending machinery, and only sixteen days in boring. On the 25th, on lowering the scraper, it was stopped by pieces of iron. A bag of sand was then dropped down the well to mix with these, and after twenty-four attempts, using scraper, pump, and kit extractor, alternately, we succeeded in freeing the well from all the iron exposed to the action of the tools. When it is considered that it occupied one hour and fifteen minutes to lower scraper and kit extractor, each time, the time lost when the men were working only eight hours per day can be readily estimated. The result of this month's progress through this mass was only 32 feet, which must not be regarded in the principal result of boring the well. From the weight of the iron extracted and the depth bored through, it was calculated that if the remaining 31 feet of *debris* were as rich in sheet-iron as this had been, then there were still some 50 pounds of metal yet to be extracted. This iron working down and sinking as the well is bored out, and the tools continually striking against it dulls them very rapidly.

The first portion of September was entirely occupied in trying to remove this metal from the well without using up the drills, which are very expensive. Various expedients were tried, and inexpensive tools used, such as drills with sharp points, scrapers, hooks, augers of different shapes, and pumps without valves; but after attempting to save money by employing these tools without accomplishing the desired end, the work was resumed and the regular drills, pumps, &c., finally effected our purpose. On the 9th instant the drill unscrewed from the rods and was left in the well. On Monday, the 11th, it was raised by using a

pump made expressly so that the shank of the drill could pass through the lower valve, which had a very stiff spring. This pump was fastened to the end of the rods and not to the wire rope, which was generally used with it, and the drill was raised on the first trial. On the 26th of September the old bottom of well was reached by the tools, and we were now exactly where we would have been had we not experienced the accidents which occurred to the 7-inch pipe last year. These misfortunes of last year cost this year forty-four days of work and an expenditure of $770. On this day, when we had left the effects of the accidents of last year behind us, and the drill was sinking deeper than ever, another misadventure befell the well. In lowering the pipe the chain which held it had to be slackened to allow it to start on its downward course, with the lever. Suddenly the pipe rushed down, and being jerked back by the chain when the latter had taken up the slack, several rivets which held the pipe together broke, 17 feet from the surface of the ground, and the lower portion of the pipe sunk to the bottom of the well, but it was ascertained, by using the gauge, that the pipe was uninjured below the rupture. The experience of last year, which we fully remembered, of the difficulty which attended the raising of this very pipe, warned us to resort to any other expedient that could be adopted before we attempted this again. It was therefore determined, as the break had happened so near the top and the greater portion of the pipe was uninjured, to sink a shaft to the top of the pipe in the well, and to connect the lower portion of it with a new section of pipe. This accident was entirely unexpected, as, in testing the strength of the rivets before use, we had proved that five of them could sustain 10,000 pounds. The pipe weighed 11,500 pounds in air, and only 9,800 in water, and each joint was fastened with eight of these rivets, which, if perfect, should have been equal to a strain of 16,000 pounds, or nearly twice as much as the weight of the pipe. Some of them, however, were imperfect, which could not be ascertained on inspection.

By the 8th of October the shaft was sunk and curbed with plank, the 11, 9, and 8 inch pipes were cut through 20 feet from the surface of the ground, and the new sections of 7-inch pipe were riveted on; the 8-inch pipe, which contained the water which was struck at 960 feet level, was replaced and fastened to the portion in ground. The annular space between the 11 and 9 inch pipes was filled with cement and iron filings, to keep the water of the well in the interior pipes, the mixture used being three parts of sand, two of cement, and one of iron filings. This preserves the water already obtained from escaping into the bay through the leaking of pipes and the soil. The boring was not resumed until the 16th, the time being occupied in securing the foundation of well-tower, wedging the sills, refitting the floor, and making a new tool to cut up and under the pipe. This last was necessary, as the lower part of pipe had sunk to the bottom, and we could not use under it the regular side cutters with which we worked down, as, to employ these side cutters, room had to be made for them under the pipe. We attempted to bore first without using this tool, but our attempts were not successful. The old side cutters would not work or cut away on any side; they could not be turned, and it was only by using great power that we could draw them up into the 7-inch pipe and get them out of the well. The cause of this difficulty can be readily perceived: the side-cutter frame filled the pipe to within one-sixteenth of an inch, and the bore below the pipe was of the same diameter, but it being eccentric with the pipe caused an amount of friction which the weight of the rods and tool, with side cutters closed in the descent of the latter, overcame. On raising, however, the power re-

quired to close the side cutters, raise the weights above mentioned, and to overcome the friction, has to be increased to such a degree as to threaten the safety of the pipe and tool. It was, therefore, considered expedient to make and use this new tool for cutting up and under the pipe before using this drill and these side cutters. To do this required the work of four days under pipe; the bore was drilled down and the tool cut a space below the pipe large enough to allow the regular side cutters to be worked. The bore was enlarged up to within less than an inch of the bottom of the pipe, and the tool being then removed and pressure applied to the pipe, the steel ring, with which the bottom of the pipe was re-enforced, cut through this inch easily, and the pipe was ready to descend freely. This tool for cutting under and up is also called an "expanding-tool," and will be referred to below by this latter name, as it was employed frequently to effect another purpose. It consists of two main



vertical straps to support cutters; two guide-plates, assembled and fastened to wedge by four rivets, their edges projecting on both sides half way over straps to form grooves for the latter; one inverted wedge, with two stay-pins at bottom, fastened to a slide-box at top; two steel cutters, with serrated teeth, fastened to main vertical slides by seven-eighth inch screws; two re-enforcing straps above cutters, one on each side, to assist in keeping cutters in place; one vertical fork, fastened by bolt and

nut, to move box and wedge, to which a wire rope from the surface is attached. This rope enables the workman to pull box and inverted wedge up. The latter lies between the main vertical straps, and when raised expands them and the cutters under the pipe.

On reaching a distance of 1,099 feet from the surface, the stratum changed to that of hard sand-rock, and the tools immediately gave evidence of this change. The progress made this month, on account of the extra work performed, was only 10½ feet.

In November, as the pipe continued to move freely, the number of hours worked out of the twenty-four was eight, as there was no reason for increasing them beyond the number prescribed by the Government for a day's work. The bore was deepened on the 1st instant 1 foot 5 inches; on the 15th instant, 2 feet; on 27th instant, 3 feet 3 inches, and on the 29th of the month, 3 feet 5 inches. This increasing progress was owing to the tools working better and the nature of the soil, the latter changing from hard sand-rock to sand and shale, and finally to shale. This stratum of shale seems without limit in extent.

We bored twenty-four days this month, only leaving one day for repairs, and made excellent progress. The bore was deepened 28 feet 8 inches, and the daily average for eight hours' work was 1 foot 8 inches. On the 4th of this month a new difficulty presented itself, which might have caused a serious accident if certain precautions had not been immediately adopted. The 7-inch pipe is now 1,100 feet long, and hanging to a depth of 960 feet, free, within the 8-inch pipe. This was a dead weight, nearly all of which had to be supported from above; the friction between the walls of the well and the 149 feet of 7-inch pipe extending below the 8-inch was not sufficient to support the weight of the pipe; the spring of the pipe in this length as it hung in the well was 8 inches. When, therefore, the pipe was loosened from its supports above, it appeared to descend, although the bottom of the pipe did not move until the pipe was sprung to the above extent, and then the weight of the pipe overcame the friction below and it suddenly fell to the extent of its spring. This dropping of the pipe for a distance of 8 inches, weighing as it did 11,000 pounds, evolved a living force which might be sufficient to rupture the pipe. To guard against this occurrence, every time the pipe was to be lowered the expanding-tool, described above, was let down into the well below the bottom of the pipe, the wedge was hauled up by the wire rope, and the side cutters thus pressed out and under the pipe. Then by lowering the system of rods gently the pipe sunk into the well, and the sudden jerk which was due to the spring of the pipe was prevented, and the injurious results which it might have caused, avoided.

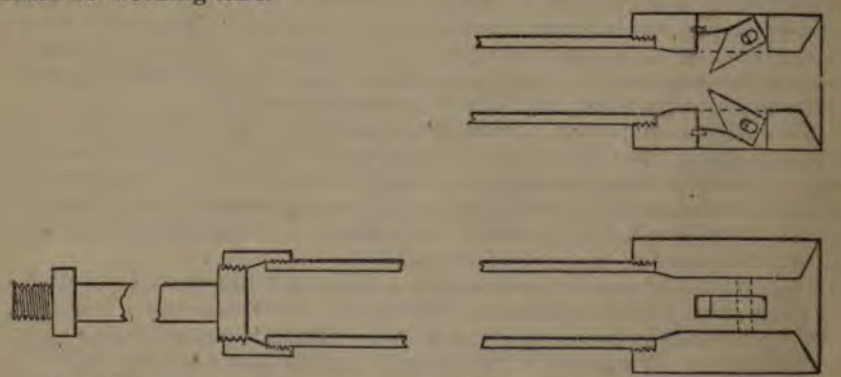
This method of piping, although occupying much time, had to be used, at least until the friction between the wall of the well and the pipe below the 8-inch pipe had increased sufficiently to bear the whole weight of the pipe, so that it could not descend suddenly any distance after it was started by pressure from above. It takes one hour and a quarter to lower this tool into its position.

On the 11th the side cutters struck against a bowlder in the side of the well, which broke them, and caused some detention; only 7 inches of boring was made, which was but half the distance accomplished on the previous day. Three days' work carried the drill and cutters below the trouble, and the usual work of 1 foot 5 inches was accomplished. The pipe gradually required more and more pressure to start it in its descent, and on the 18th instant there was no longer a necessity of using the expanding-tool to check its descent. This decrease of pressure was due to the increase of friction, which seemed greater than that which was

the natural consequence of the increase of surface of pipe in contact with the earth. The pipe was gauged and the well-hole below it, and they were found straight, circular, and the latter necessarily large to avoid this friction if possible, therefore there was no fault in the work. This undue increase of friction must be owing to caving in the well, which is the unseen enemy of well-borers, especially when the axis of the well makes an acute angle with the lines of strata through which it passes. In horizontal strata there is hardly any of this caving, and, when it does occur, it is confined to the earth forming the wall of the well itself; but in our case, when the layers are nearly vertical, the shale and rotten rock may be brought by the force of gravity for some little distance from the well into it. This increase of friction and the proportional increase of pressure required to move the pipe down proved that it was no longer in suspension, and that it would soon be necessary to increase the hours of work, so that the pipe might not become fixed.

The week ending on the 25th of the month was very satisfactory in results. The drill passed through alternate layers of shale and shale mixed with sand, and no accident or detention was experienced. The men were boring twenty-one hours and twenty minutes, and the distance bored was 9 feet 1 inch. The remainder of the time, *i. e.*, twenty-six hours and forty minutes, was occupied in cleaning out the well and piping. These figures will convey an idea of the amount of time expended in the ordinary occupations at the well, and one will see at a glance that during the most favorable progress of the work the time actually occupied in boring is less than that required for the other operations, and this extra time will increase as the well is deepened.

At the end of this month the engine and boiler could not perform the required work, and it was found necessary to substitute wooden poles for some of the iron rods, thus decreasing the weights to be raised. This substitution would multiply the chances of breakage. For although the wood for these poles had been carefully selected, yet any sudden twist or unexpected strain caused by the tools catching in the pipe or well would certainly rupture them; but it was "Hobson's choice," for there was no money to replace engine or boiler. Before using the poles a precaution was adopted, of making a tool with which they could be raised from the well in case of breakage with a loss of only two or three hours of working-time.



A parachute of sole leather, nearly filling up the pipe, was fastened to the upper end of the iron rods, so that when the poles broke the resistance of water against it as the tools and rods sank would buoy them up and prevent the rods or tools from acquiring accelerated

motion, thus saving both from injury in falling to the bottom of the well. This tool consists of a rod to connect it with boring-rods, at the bottom of which is screwed an iron pipe to fit over the top of wooden poles that may be broken in the well; to this is screwed a hollow iron cylinder of an equal diameter to interior of pipe; the lower part of it is turned to an edge. In the opposite sides of this cylinder are two slots; in these two pawls are fastened with iron pins; the holes for these pins are elliptical. The pawls are kept closed by two weak springs, which will allow poles to pass up into cylinder and pipe, but as soon as the tool is raised the pawls catch the pole between them and are forced down so as to rest on the bottom of the slots, which are solid. The pole then has to break off or is raised out of the well.

On the last of this month the wall of the well commenced to cave, which might have been expected from the soft character of the stratum through which the drill passed during the latter portion of it. The daily reports have to be kept very carefully, as the superintendent each morning, before commencing work, has to read them over and realize fully and in every particular the exact condition of the well as he left it the night previous before he undertakes to insert a tool. For instance, the one for November 1 reads as follows: "Pumped four times, changed side cutters, lowered tools, and bored from 11 a. m. to 2.15 p. m., advancing 1 foot 5 inches. Had to stop suddenly, and raised tools in pipe, because check-valve in feed-pipe of boiler had broken off at the collar. It was soldered on while a new one was being made. While this was being done, made new piece for valve-gear, which had broken out. Two drills were sharpened at the shop. Then lowered pipe 2 feet 6 inches. It had to be started, but then went down by jars. Used expanding tool to hold pipe and prevent it from being jarred too much. Bored three hours and fifteen minutes. Strata, sandy shale; depth of well, 1,105 feet 7 inches; depth of pipe, 1,096; depth of well to shoulder, 1,102 feet 3 inches." Thus the exact condition of the well was ascertained each evening before quitting work, so that any accident which occurred during the night, and the damage effected by it, could be readily estimated.

During the last portion of this month, as the pipe began to require more pressure to lower it in the well, and as the walls had commenced caving, it was resolved that, in order to keep the pipe in motion and prevent it from becoming fixed, the work should be continued for sixteen hours at a time, by two gangs of operatives, one working from 6 a. m. to 2 p. m., and the second to 10 p. m., changing every Sunday. The adoption of this system kept the tools in the well two-thirds of the time, and the pipe only remained stationary for eight hours, and did not become "set," as it is styled. The advancement of the work was proportional to the increase in the number of working-hours, as will be readily seen in reading the report of work performed in December. In case of an accident the most experienced of men of both gangs worked until the results of it were rectified.

I would here state the result of our experience in one respect, and that is, that the men who make or repair tools should be distinct from the well-borer's gang.

We have had to employ the superintendent of the well, Mr. E. Bandel, to make and repair tools, as he was the only machinist at the arsenal capable of performing this work; and while he was thus employed the work at the well was jeopardized.

In December twelve wooden poles were substituted for a corresponding length of iron rods, and the engine immediately proved its appreciation of our consideration. The strata encountered was shale, which

changed on the seventh to yellow sand rock, and subsequently to blue sandstone, which is of greater density than the former.

During the first week three hours were lost by the pump escaping from the workmen and dropping to the bottom of the well. The best day's work in the first half of the month was 3 feet 8 inches. The 12th and 13th instant were occupied in repairing the free-falling apparatus, of which we had but one, on the score of economy, when we should have had two of them. All tools should be duplicated except the drills, of which there should be four or even more.

On the 15th instant the well was deepened 4 feet 2 inches, and on the 18th 4 feet 3 inches. Both are excellent results when the depth of well, 1,179 feet, is considered, and the density of the blue sandstone. There is one objection to employing two gangs of men, namely, their ambition to excel each other in the actual progress made. The haste consequent to this is frequently the cause of a crooked bore, and then the work has to be done over again, or the pipe, not being concentric with the bore, will become unavailable.

On the 16th we commenced measuring the force necessary to push the pipe down, by observing the upward spring of the pipe when relieved from this pressure. This was a comparative test of the resistance of the pipe to motion, and proved how it increased daily. On the 4th instant three boring-shifts were made, from 6.05 to 9 a. m., from 1.40 to to 4.40 p. m., and from 7.10 to 9.55 p. m., amounting to eight hours and forty minutes, which resulted in sinking the well 4 feet 4 inches.

On the 25th the drill encountered a layer of very hard rock, and only 10 inches were made by both gangs. A fault was discovered on the last of the month; the side cutters would not pass through thepipe without more pressure from above than was deemed necessary, and the difficulty occurred especially at a distance of 1,150 feet from the surface. On examination the pipe was found perfect; no break or rag of metal projecting inwards or loose rivet could be discovered. The cylinder-gauge, however, showed a flattening of the pipe at the above-mentioned spot of about one-sixteenth of an inch. A shell with a band around it was screwed to the end of the rods and was forced up and down until the pipe was ironed out to its full dimensions.

The progress made this month was 69 feet 9 inches, which was twice as great as that made during the previous month, and proved that the gangs of men worked at night as faithfully as they did during the day. The well was piped 1,212 feet 7 inches from the surface of ground to within 8 feet 7 inches of the bottom of the well.

On the 2d day of January the drill struck a bed of lime rock which proved very dense, and the sharpening of the drills retarded progress, as they had to be withdrawn frequently to have others substituted for them. On the 5th instant, the upward spring of the pipe, after the pressure to push it down had been removed, was noticed to be one inch and a half, which was considered equivalent to not less than 12 tons. The daily progress was fair until the 21st instant, varying from 2 feet 2 inches to 3 feet 8 inches, without an occurrence of any accident worthy of special mention, and the difficulty of boring did not increase materially, but the pipe continued to require an increased pressure to move it. The spring of pipe when relieved was one and sixty-two hundredths of an inch and there was danger of telescoping the pipe. In order to prevent this difficulty from increasing, which it always did during the suspension of work, the state of rest allowing time for the soil from the cavings to settle around the exterior of the pipe and to harden, it was resolved to work continually night and day. This time-table was to be

continued until the pipe became fixed, or until the money for this work was expended. After the above date each gang of men worked twelve hours at a time and changed on Sunday. On January 22 the pump stuck fast in the bottom of the well, and ten hours were lost in extracting it, which was only effected by main force, using the heaviest iron rods and two hydraulic pumps, each of 15 tons capacity. The cylinder-gauge was then used, and after ascertaining that the pipe was flattened in certain places, the shell was forced down to round the pipe out to its original shape. The tool for cutting under the pipe was employed to enlarge bore beneath it, and the steel ring at bottom of pipe was felt all round with the cutters to ascertain that all was free below it. The cylinder gauge then reached the bottom of bore and found everything clear and the work was resumed.

On the 27th of this month, although every precaution which could be suggested was adopted, the spring of the pipe increased to 2½ inches, and on the 29th it reached 4 inches. There was no reason for this, unless the wall was caving more than we had supposed, allowing a spall of rock to fall under the steel ring. The pressure to push the pipe was used very gradually, and it was expected every instant that the pipe would be broken; but finally it started downward, and the spring of pipe decreasing the next day proved that our surmises had been probably correct. The progress on the last day of this month was 4 feet 3 inches through shale, and the whole effect of the month's work was to deepen the well 71 feet 4 inches. The tools were working well, but the pipe was now in contact with the earth for 319 feet of its length, or 638 square feet of its surface, and it was a grave question, considering that the pipe was made of sheet-iron, how long this power of adhesion to the side of the well would be under control.

Five and a half hours were consumed on February 1 in lowering pipe a distance of 5 feet, the chain which was used being broken and the hook bent straight. After the pipe was started it went down with the use of only one hydraulic pump. Orders were given after this for every shift of workmen to pack the pipe to insure its being moved at least once every twelve hours, and with the view to render the inertia experienced in starting it less. On the 2d the drill struck a bowlder and was broken, the gas which had been coming up the pipe disappeared, and the spring of the pipe, when relieved from pressure, was only 3 inches. The strata became more yielding on the next day, and the pipe was lowered 5 feet in three hours. Another bowlder was encountered by the drill on the 10th, and broke its edges off; this was done before the workman at the top of the well was aware of any difficulty below. Always as soon as the presence of one of these obstacles is ascertained the stroke is immediately reduced, and, sometimes, the side cutters are removed and the drill used alone until the bowlder is perforated, then the side cutters are again used with a reduced stroke to enlarge the hole. The danger to be guarded against in encountering a bowlder results from its position in the well-hole, if on one side of the axis of the bore, or its being of unequal thickness. In either of the above cases the drill is forced from its vertical position, and the bore becomes eccentric to the portion above, and the pipe will be bent in its descent. Therefore, after piercing one of these stones, the bore has to be gauged carefully, and often the well-hole has to be straightened before the pipe can descend. The bowlder, in this instance, was 2 feet thick, and impeded our progress for several days; below it shale was found.

On the 12th, when the drill was being raised, the side cutters caught underneath the pipe and the wooden poles broke, the iron rods and tools falling to the bottom of the well, but without injury to them on

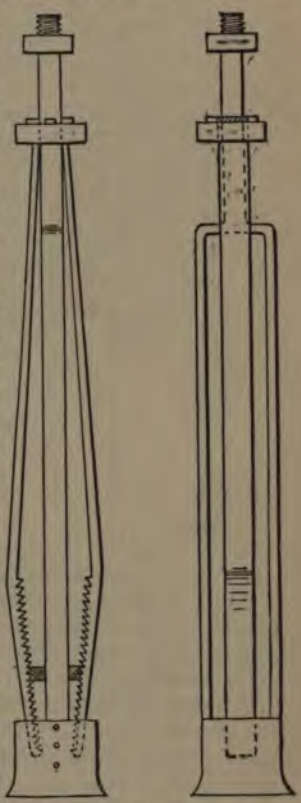
account of the sole-leather parachute. Four hours were lost in raising tools and rods out of the well. The rock bored through the next day was very hard, and the progress made by each gang was small. On the 15th the screw of boring-bar broke off, leaving the free-falling apparatus and tools in the well. A hold on it was easily obtained, and it was raised 120 feet, when it slipped. Its position was ascertained, and it was seized and raised again several times to different heights, escaping each time. Finally, after six hours' work, it was extricated from the well. The rock passed through for several days was hard siliceous shale, and changed on the 20th to slate, the pump bringing up spalls of this rock which had been chipped off by the drill. The drill worked to one side through the siliceous shale, and the axis of the bore was not an extension of the axis of the pipe. The bore had to be enlarged, straightened, and gauged before the work could be continued. When the power is employed at such a distance from the surface, *i. e.*, 1,356 feet, it is very difficult to ascertain when the bore commences to deviate from a vertical line, especially when we consider the elasticity possessed by the iron poles. The fact is demonstrated, however, by the result, and this is the first information we possess that the work is not proceeding properly. The progress made this month was 79 feet 5 inches. At the beginning of this month, *i. e.*, on the 5th instant, knowing that the appropriation for this work was nearly expended, I reported this fact to the Ordnance Office, and also that when the work stopped the 7-inch pipe would become immovable, and could not be used unless we first raised it from the well. We had expected to reach a depth of 1,500 feet with pipe of this caliber, but this anticipation could not be realized without an increased expenditure of money. Having heard from Washington that no funds could be appropriated for prosecuting this undertaking, it was necessary to determine how the small balance on hand could be spent to the best advantage, and the work was continued for a few days in March while I could decide this matter.

On the 2d instant the screw of boring-bar was broken in the well as on a former occasion, and this was due to the fact that no space was left between the top of male screw on the bar and the bottom of female screw on the coupling of rod above, so that when the bar was screwed up the surfaces were in contact and a jerk broke the screw off even with shoulder on bar. This was raised successfully after repeated trials, and the work continued night and day until the 6th of the month. The pipe was then pushed down until it rested on the shoulder made by side cutters; this distance was 1,372 feet 9 inches from surface of ground, and more than a quarter of a mile of pipe was now in the well, the bore being 5 inches longer than the pipe. I now determined to stop piping, the men were dismissed, and the work as heretofore systematically performed was discontinued. I left the pipe at this point and concluded to use the remainder of the money on hand to bore without side cutters in hopes of obtaining a third stream of water.

The work was resumed on the 13th by the superintendent, E. Bandel, and the enlisted men, working eight hours a day. The time was reduced but the progress made continued good, for the side cutters had been abandoned. The boring was through strata of sandstone and shale until the 21st, when the screw on the drill itself, below the boring-bar, broke off, leaving the drill in the well. The cause of this fracture was not owing to any imperfection in the tool, but to the want of homogeneity

in the stratum and the manner in which the drill was worked. The drill struck on a shelving stratum of hard rock, which made it fly off to one side, and if it could have swerved a little from the axis of the boring-bar and well it would not have broken, but, in order to maintain the drill in the center of the bore, the boring-bar was held tight in the axis of the well by a stiff guide just above drill, so that the latter had no play; this rigidity caused its fracture, as the drill had to keep straight or break. The reduction of weight of the rods and tools by the breaking of the drill was only 60 pounds and of too trifling a character to be perceived at the top of the well. The boring-bar gradually worked its way down alongside of the drill, crowding the latter into the wall. The hardness of the rock prevented it from imbedding itself entirely, and it lay in an inclined position.

The work continued, and the end of the boring-bar striking the side of drill constantly with a weight of 590 pounds, falling a distance of 20 inches, ground a hole into the iron of which the drill was made. No progress being made, the rods were drawn up, and the accident which had occurred was discovered. Its inclined position prevented its being extricated until it was changed. A hook, bent to the curvature of the well, was made, lowered on the rods, and turned until its point was between the drill and wall of well. By a further turn, it brought the shank of drill from side of well toward its center.



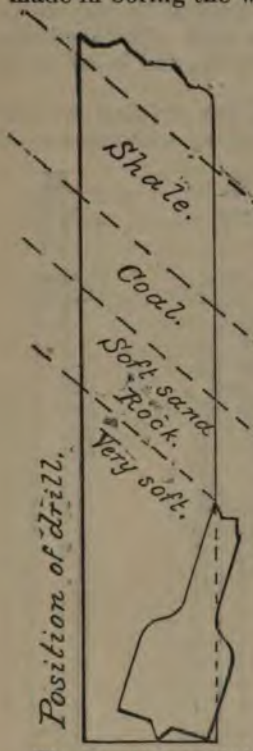
A large pump, the valve being removed, was lowered over drill, and the mud around the bottom of the latter was rammed and packed, so as to keep the drill from again falling against side of well. This was a necessary precaution, or the drill, when the new tool, which can be called an "alligator tool," was feeling for the top of it, would have fallen again to the wall of the well.

The pump was then withdrawn, and the kit-extractor, by the impression made on it by top of drill, showed that there was a sufficient space on the sides of the shank for the jaws of the new tool to get a hold. This tool, on the second trial, brought the drill out of well. It consists of an iron frame, made in the shape of a large tuning-fork, the shank of the fork having a shoulder and screw, by which it is fastened to the system of boring-rods. At the extremity of the prongs, and riveted to them, is an iron cylinder, with a flaring bottom edge of the same diameter as the pipe, which guides the top of any broken rod in well up between the prongs of the fork as the tool is lowered over it. An iron collar works on the shank of the fork, and holds vertically two long steel springs, which pass up the cylinder, the plane of these springs being perpendicular to the plane of the prongs of the fork. The lower inside edges of these springs are cut into serrated surfaces.

To use this tool, force the serrated faces of springs apart and place a block of wood between them; screw the tool to the rods, and lower it into the well. When the tool is let down, the head of the broken pole in well is guided by the cylinder between the springs. Press down quick-

ly, and the block will be forced out by the head of the pole, and the springs will slide down as far as the collar on the shank will allow. In pulling up, the teeth of the springs will seize the sides of the rod, and it can be raised from well.

The strata passed through this month contained shale and sand, mixed. The average daily progress during the first six days, when the men were piping and working twenty-four hours, was 2 feet 5 inches, and during the remainder of the month it was 1 foot 7 inches. The total progress made in boring the well in this month was 31 feet 10 inches.



In April the work was continued with the enlisted men, and the strata bored through was shale until the 9th, when hard sand-rock was struck. On the 11th signs of coal appeared in the pump.

The next day, on reaching a depth of 1,407 feet 10 inches, the well was filled with inflammable gas, which burned with a yellow flame at the mouth of the well, and a new stream of water was met which was filled with this gas. Specimens of this water and gas are now in the hands of the chemist, and his analysis of both should form a part of this report, but I have just received a telegram from the Chief of Ordnance directing me to forward my report immediately, and the results of his labors will be submitted in a special report. The drill broke off again in the well on this day, and many ineffectual efforts were made to recover it, until the appropriation failed. In order to use the water in this well this summer, which is much needed on account of the small amount of rain which has fallen this year, the deep-well pump was put down 200 feet, and the lever was attached to the piston-rods. Whenever the water is pumped a large amount of gas comes up with it, and can be lighted at the reservoir nearly 200 feet above the well, as it issues with the water from the pipe which conducts the water from this well to the former.

The condition of the well is as follows: The 11, the 9, and the 8 inch pipes are as stated in the beginning of this report. The 7-inch pipe extends 1,373 feet down the well, and the bore of well is 1,407 feet and 10 inches deep.

An appropriation is the only thing that is needed to insure a successful issue to this undertaking. All the tools are on hand, and an experience has been bought. A company is boring for coal 15 miles from here with a diamond drill, but their success has not equaled that obtained at this arsenal with the tools that have been adopted and used for the first time in this country.

There is no originality claimed for most of the tools, as they were obtained from Mr. Kline's book, a German well-borer, as has been stated before, but in adapting them to our use and in making new ones, especially those set forth in this and my last report, credit must be accorded to Mr. E. Bandel, who has been indefatigable in his efforts of mind and body.

I am, general, very respectfully, your obedient servant,

J. McALLISTER,

Lieutenant-Colonel of Ordnance, Commanding.

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